Gurugram University Gurugram

Curriculum for UG Degree Course in

Computer Science and Engineering (ARTIFICIAL INTELLIGENCE & DATA SCIENCE)

Gurugram University, Gurugram

GENERAL COURSE STRUCTURE & CREDIT DISTRIBUTION

STRUCTURE OF UNDERGRADUATE ENGINEERING PROGRAM

S. No.	Category	Breakup of Credits (Total 160)
1	Humanities and Social Sciences, including Management courses	11
2	Basic Science courses	16
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	34.5
4	Professional core courses	63
5	Professional Elective courses relevant to chosen specialization/branch	12
6	Open subjects – Electives from other technical and /or emerging subjects	12
7	Project work, seminar and internship in industry or elsewhere	16
8	Mandatory Courses [Environmental Sciences, Induction training, Constitution of India, Essence of Indian Traditional Knowledge]	Non-credit
	Total	**164.5**

SEMESTER-WISE SUMMARY OF THE PROGRAM

S. No.	Semester	No. of Contact Hours	Credits	Marks
1.	I	25	19.5	900
2.	II	25	22	900
3.	III	28	22	1000
4.	IV	26	22	1000
5.	V	29	22	1000
6.	VI	26	22	900
7.	VII	27	21	900
8.	VIII	22	14	500
	Total		164.5	7100

COURSE CODE AND DEFINITIONS

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences, including Management courses
PCC	Professional core courses
PEC	Professional Elective courses
OEC	Open Elective courses
LC	Laboratory course
MC	Mandatory courses
PT	Practical Training
PROJECT	Project

CREDIT DISTRIBUTION IN THE FIRST YEAR OF THE UNDERGRADUATE ENGINEERING PROGRAM

Bachelor of Technology (SCHEME A1) Semester-1

Sr. No.	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit
			L	T	P		
1.	HSE-101	Communication Skills in English	2	0	0	2	2
2.	BSM-101	Mathematics-I	3	1	0	4	4
3.	BSP-101 OR EEE-101	Physics OR Basic of Electrical and Electronics Engineering	3 3	1 0	0 0	4 OR 3	4 OR 3
4.	CSE-101	Programing for problem solving using C	3	0	0	3	3
5.	ENV-101	Basics of Environmental Science	2	0	0	2	2
6.	HSE-101P	Communication Skills in English (P).	0	0	2	2	1
7.	BSP-101P OR EEE-101P	Physics (P) OR Basic of Electrical and Electronics Engineering (P)	0	0	2	2	1
8.	CSE-101P	Programing for problem solving using C (P)	0	0	2	2	1
9.	CSE-103P OR MEE-102P	Engineering Graphics (Web Design) OR Workshop Practices (P)	1 1	0 0	2 3	3 OR 4	2 OR 2.5
10.	AUS-101	Sports (Audit Course) Compulsory	0	0	2	2*	0
						24+2*	**20/19.5**

Bachelor of Technology (SCHEME A1) Semester-2

Sr. No.	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit
			L	T	P		
1.	BSM-102	Mathematics-II	3	1	0	4	4
2.	HSV-102	Human Value & Soft Skills	2	0	2	4	3
3.	EEE-101 OR BSP-101	Basic of Electrical and Electronics Engineering OR Physics	3 3	0 1	0 0	3 OR 4	3 OR 4
4.	CSE-102	Data Structure Using C	3	0	0	3	3
5.	CSE-104	Object Oriented Concepts and Python Programming	3	0	0	3	3
6.	EEE-101P OR BSP-101P	Basic of Electrical and Electronics Engineering (P) OR Physics (P).	0	0	2	2	1
7.	CSE-102P	Data Structure Using C (P)	0	0	2	2	1
8.	CSE-104P	Object Oriented Concepts and Python Programming (P)	0	0	2	2	1
9.	MEE-102P OR CSE-103P	Workshop Practices (P) OR Engineering Graphics (Web Designing)	1 1	0 0	3 2	4 OR 3	2.5 OR 2
Total						**27**	**21.5/22**

HUMANITIES & SOCIAL SCIENCES, INCLUDING MANAGEMENT (HSMC)

S. No.	Code No.	Course Title	Hours Per week			Total Credits	Semester
			L	T	P		
1.		Communication Skills in English	2	0	2	3	I
2.		Basics of Environmental Science	2	0	0	2	I
3.		Human Value & Soft Skills	2	0	2	3	II
4.		Economics for Engineers	3	0	0	0	V
5.		Organizational Behaviour	3	0	0	3	VII
Total Credits						**11**	

BASIC SCIENCE COURSES (BSC)

S. No.	Code No.	Course Title	Hours Per Week			Total Credits	Semester
			L	T	P		
1.		Mathematics-I	3	1	0	4	I
2.		Mathematics-II	3	1	0	4	II
3.		Physics	3	1	2	5	II
4.		Discrete Mathematics	3	0	0	3	III
Total Credits						**16**	

ENGINEERING SCIENCE COURSE (ESC)

S. No.	Code No.	Course Title	Hours Per Week			Total Credits	Semester
			L	T	P		
1.		Basic of Electrical and Electronics Engineering	3	0	2	4	I
2.		Programming for problem-solving using C	3	0	2	4	I
3.		Workshop Practices(P)	1	0	2	2.5	I
4.		Data Structure Using C	3	0	2	4	II
5.		Object-Oriented Concepts and Python Programming	3	0	2	4	II
6.		Engineering Graphics (Web Design)	1	0	2	2	II
7.		Digital Electronics	3	0	2	4	III
8.		R-Programming	3	0	2	4	IV
9.		MOOC - I (Essential)	3	-	-	3	VIII
10.		MOOC - II (Essential)	3	-	-	3	VIII
Total Credits						**34.5**	

PROFESSIONAL CORE COURSES (PCC)

S. No.	Code No.	Course Title	Hours Per Week			Total Credits	Semester
			L	T	P		
1.		Advance Data structures	3	0	2	4	III
2.		Database Management Systems with SQL	3	0	2	4	III
3.		Programming for Data Science & AI	3	0	2	4	III
4.		Artificial Intelligence	3	0	0	3	III
5.		Operating System	3	0	2	4	IV
6.		Programming in Java	3	0	2	4	IV
7.		Design & Analysis of Algorithms	3	0	2	4	IV
8.		Computer Organization & Architecture	3	0	0	3	IV
9.		Computer Networks	3	0	0	3	IV
10.		Formal Languages & Automata	3	0	0	3	V
11.		Big Data Analytics	3	0	2	4	V
12.		Machine Learning and its Applications	3	0	2	4	V
13.		Compiler Design	3	0	0	3	VI
14.		Statistical Computing	3	0	2	4	VI
15.		Predictive Analytics	3	0	2	4	VI
16.		Deep Learning	3	0	2	4	VI
17.		Intelligent and Expert System	3	0	2	4	VII
Total Credits						63	

PROFESSIONAL ELECTIVE COURSES (PEC)

S. No.	Code No.	Course Title	Hours Per Week			Total Credits	Semester
			L	T	P		
1.		Professional Elective Course - I	3	0	0	3	V
2.		Professional Elective Course - II	3	0	0	3	VI
3.		Professional Elective Course - III	3	0	0	3	VI
4.		Professional Elective Course - IV	3	0	0	3	VII
Total Credits						**12**	

OPEN ELECTIVE COURSES (OEC)

S. No.	Code No.	Course Title	Hours Per Week			Total Credits	Semester
			L	T	P		
1.		Open Elective Course – I	3	0	0	3	V
2.		Open Elective Course - II	3	0	0	3	VI
3.		Open Elective Course - III	3	0	0	3	VII
4.		Open Elective Course - IV	3	0	0	3	VII
Total Credits						**12**	

PROJECT WORK, SEMINAR AND INTERNSHIP IN INDUSTRY OR ELSEWHERE

S. No.	Code No.	Course Title	Hours per week			Total Credits	Semester
			L	T	P		
1.		Practical Training - I	0	0	2	1	V
2.		Project - I	0	0	4	2	VI
3.		Practical Training - II	0	0	2	1	VII
4.		Project - II	0	0	8	4	VII
5.		Project - III	0	0	16	8	VIII
Total Credits						**16**	

Semester-wise Structure and Curriculum for

UG Course in

Computer Science and Engineering (ARTIFICIAL INTELLIGENCE & DATA SCIENCE)

Gurugram University
Scheme of Studies and Examination
Bachelor of Technology (SCHEME A1) Semester-1

Sr. No.	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit
			L	T	P		
1.	HSE-101	Communication Skills in English	2	0	0	2	2
2.	BSM-101	Mathematics-I	3	1	0	4	4
3.	BSP-101 OR EEE-101	Physics OR Basic of Electrical and Electronics Engineering	3 3	1 0	0 0	4 OR 3	4 OR 3
4.	CSE-101	Programing for problem solving using C	3	0	0	3	3
5.	ENV-101	Basics of Environmental Science	2	0	0	2	2
6.	HSE-101P	Communication Skills in English (P).	0	0	2	2	1
7.	BSP-101P OR EEE-101P	Physics (P) OR Basic of Electrical and Electronics Engineering (P)	0	0	2	2	1
8.	CSE-101P	Programing for problem solving using C (P)	0	0	2	2	1
9.	CSE-103P OR MEE-102P	Engineering Graphics (Web Design) OR Workshop Practices (P)	1 1	0 0	2 3	3 OR 4	2 OR 2.5
10.	AUS-101	Sports (Audit Course) Compulsory	0	0	2	2*	0
						24+2*	**20/19.5**

Gurugram University

Scheme of Studies and Examination

Bachelor of Technology (SCHEME A1) Semester-2

Sr. No.	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit
			L	T	P		
1.	BSM-102	Mathematics-II	3	1	0	4	4
2.	HSV-102	Human Value & Soft Skills	2	0	2	4	3
3.	EEE-101 OR BSP-101	Basic of Electrical and Electronics Engineering OR Physics	3 3	0 1	0 0	3 OR 4	3 OR 4
4.	CSE-102	Data Structure Using C	3	0	0	3	3
5.	CSE-104	Object Oriented Concepts and Python Programming	3	0	0	3	3
6.	EEE-101P OR BSP-101P	Basic of Electrical and Electronics Engineering (P) OR Physics (P).	0	0	2	2	1
7.	CSE-102P	Data Structure Using C (P)	0	0	2	2	1
8.	CSE-104P	Object Oriented Concepts and Python Programming (P)	0	0	2	2	1
9.	MEE-102P OR CSE-103P	Workshop Practices (P) OR Engineering Graphics (Web Designing)	1 1	0 0	3 2	4 OR 3	2.5 OR 2
Total						**27**	**21.5/22**

B.Tech. (Computer Science and Engineering- Artificial Intelligence & Data Science)
Scheme of Studies/Examination w.e.f. 2023-24

Semester- III

S.No.	Category	Course Code	Course Title	Hours Per week			Total Contact Hrs per week	Credits	Examination Schedule (Marks)			
				L	T	P			Marks of classwork	Theory	Practical	Total
1.	**ESC**		Digital Electronics	3	0	0	3	3	30	70		100
2.	**PCC**		Advanced-Data Structure	3	0	0	3	3	30	70		100
3.	**PCC**		Database Management Systems with SQL	3	0	0	3	3	30	70		100
4.	**PCC**		Programming for Data Science and AI	3	0	0	3	3	30	70		100
5.	**PCC**		Artificial Intelligence	3	0	0	3	3	30	70		100
6.	**BSC**		Discrete Mathematics	3	0	0	3	3	30	70		100
7.	**LC**		Digital Electronics Lab	0	0	2	2	1	50		50	100
8.	**LC**		Advanced-Data Structure Lab	0	0	2	2	1	50		50	100
9.	**LC**		Database Management Systems Lab	0	0	2	2	1	50		50	100
10.	**LC**		Programming for Data Science & AI Lab	0	0	2	2	1	50		50	100
11.	**MC**		Constitution of India*	2	0	0	2	0	30	70		100*
			Total	**20**	**0**	**8**	**28**	**22**	**380**	**420**	**200**	**1000**

***NOTE:** The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree. However, these marks will be shown in the detailed marks certificate of the students.

B.Tech. (Computer Science and Engineering- Artificial Intelligence & Data Science)
Scheme of Studies/Examination w.e.f. 2023-24

Semester- IV

S.N.	Category	Course Code	Course Title	Hours Per week			Total Contact Hrs. per week	Credits	Examination Schedule(Marks)			
				L	T	P			Marksof classwork	Theory	Practical	Total
1.	**PCC**		Operating System	3	0	0	3	3	30	70		100
2.	**ESC**		R-Programming	3	0	0	3	3	30	70		100
3.	**PCC**		Programmingin Java	3	0	0	3	3	30	70		100
4.	**PCC**		Design & Analysis of Algorithms	3	0	0	3	3	30	70		100
5.	**PCC**		Computer Organization & Architecture	3	0	0	3	3	30	70		100
6.	**PCC**		Computer Networks	3	0	0	3	3	30	70		100
7.	**LC**		Operating System Lab	0	0	2	2	1	50		50	100
8.	**LC**		Programming in Java Lab	0	0	2	2	1	50		50	100
9.	**LC**		Design & Analysis of Algorithms Lab	0	0	2	2	1	50		50	100
10.	**LC**		R-Programming Lab	0	0	2	2	1	50		50	100
			Total	**18**	**0**	**8**	**26**	**22**	**380**	**420**	**200**	**1000**

NOTE: At the end of 4th semester each student as to undergo Practical Training of 4/6 weeks in an Industry /Institute/ Professional Organization/Research Laboratory/training centre etc. and submit the typed report along with a certificate from the organization & its evaluation shall be carried out in the 5th Semester.

B. Tech. (Computer Science and Engineering- Artificial Intelligence & Data Science)
Scheme of Studies/Examination w.e.f. 2023-24

Semester-V

S.No.	Category	Course Code	Course Title	Hours Per week			Total Contact Hrs.per week	Credits	Examination Schedule (Marks)			
				L	T	P			Marks of classwork	Theory	Practical	Total
1.	**ESC**		Predictive Analytics	3	0	0	3	3	30	70		100
2.	**PCC**		Formal Languages & Automata	3	0	0	3	3	30	70		100
3.	**PCC**		Big Data Analytics	3	0	0	3	3	30	70		100
4.	**PCC**		Machine Learning and its Applications	3	0	0	3	3	30	70		100
5.	**PEC**		Professional Elective Course-I	3	0	0	3	3	30	70		100
6.	**OEC**		Open Elective Course-I	3	0	0	3	3	30	70		100
7.	**LC**		Predictive Analytics Lab	0	0	2	2	1	50		50	100
8.	**LC**		Big Data & Analytics Lab	0	0	2	2	1	50		50	100
9.	**LC**		Machine Learning Lab	0	0	2	2	1	50		50	100
10.	**HSMC***		Economics for Engineers	3	0	0	3	0	30	70		100*
11.	**PT**		Practical Training-I	0	0	2	2	1	50		50	100
			Total	**23**	**0**	**8**	**29**	**22**	**380**	**420**	**200**	**1000**

NOTE:

1. ***The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree. However, these marks will be shown in the detailed marks certificate of the students.**
2. **The evaluation of Practical Training–I will be based on the seminar, viva-voice, and report submitted by the students.**
3. **Choose anyone from Professional Elective Course –I**
4. **Choose anyone from Open Elective Course –I**

Professional Elective Course–I

1. Software Engineering
2. Web Technology
3. Digital Image Processing
4. Advance JAVA Programming
5. Distributed System

B.Tech. (Computer Science and Engineering- Artificial Intelligence & Data Science)
Scheme of Studies/Examination w.e.f. 2023-24

Semester- VI

S.N.	Category	Course Code	Course Title	Hours Per week			Total Contact Hrs. per week	Credits	Examination Schedule (Marks)			
				L	T	P			Marks of classwork	Theory	Practical	Total
1.	**PCC**		Data Science	3	0	0	3	3	30	70		100
2.	**PCC**		Statistical Computing	3	0	0	3	3	30	70		100
3.	**PCC**		Deep Learning	3	0	0	3	3	30	70		100
4.	**PEC**		Professional Elective Course - II	3	0	0	3	3	30	70		100
5.	**PEC**		Professional Elective Course - III	3	0	0	3	3	30	70		100
6.	**OEC**		Open Elective Course-II	3	0	0	3	3	30	70		100
7.	**LC**		Deep Learning Lab	0	0	2	2	1	50		50	100
8.	**LC**		Statistical Computing Lab	0	0	2	2	1	50		50	100
9.	**PROJECT**		Project-I	0	0	4	4	2	50		50	100
			Total	**18**	**0**	**8**	**26**	**22**	**330**	**420**	**150**	**900**

NOTE:

1. **At the end of the 6th semester, each student has to undergo Practical Training of 4/6 weeks in an Industry/Institute/ Professional Organization/ Research Laboratory/ training center etc. and submit the typed report along with a certificate from the organization & its evaluation shall be carried out in the 7th Semester.**
2. **Choose any one from Professional Elective Course–II & III**
3. **Choose anyone from Open Elective Course –II**

Professional Elective Course–II

1. Fuzzy Systems and Applications
2. Computer Graphics
3. Information Retrieval
4. Soft Computing
5. Compiler Design

Professional Elective Course–III

1. Network Security and Cryptography
2. Internet Technologies
3. Mobile applications development
4. Advance Database Management System
5. Cloud Computing

B. Tech. (Computer Science and Engineering- Artificial Intelligence & Data Science)
Scheme of Studies/Examination w.e.f. 2023-24

Semester- VII

S.N.	Category	Course Code	Course Title	Hours Per week			Total Contact Hrs. per week	Credits	Examination Schedule (Marks)			
				L	T	P			Marks of Class work	Marks of Class work	Practical	Total
1.	**PCC**		Intelligent and Expert System	3	0	0	3	3	30	70		100
2.	**PEC**		Professional Elective Course -IV	3	0	0	3	3	30	70		100
3.	**PEC**		Open Elective Course -III	3	0	0	3	3	30	70		100
4.	**OEC**		Open Elective Course -IV	3	0	0	3	3	30	70		100
5.	**HSMC**		Organizational Behaviour	3	0	0	3	3	30	70		100
6.	**LC**		Intelligent and Expert System Lab	0	0	2	2	1	50		50	100
7.	**PROJECT**		Project-II	0	0	8	8	4	100		100	200
8.	**PT**		Practical Training-II	0	0	2	2	1	50		50	100
			Total	**15**	**0**	**12**	**27**	**21**	**350**	**350**	**200**	**900**

NOTE:

1. **The evaluation of Practical Training–II will be based on the seminar,viva-voice, and report submitted by the students.**
2. **Choose anyone from Professional Elective Course – IV**
3. **Choose anyone from Open Elective Course –III & IV**

Professional Elective Course–IV

1. Cyber Security Threats
2. Network Security Applications using AI
3. Web Mining
4. Natural Language Processing
5. Image Analytics
6. Information Hiding Techniques

B.Tech. (Computer Science and Engineering- Artificial Intelligence & Data Science)
Scheme of Studies/Examination w.e.f. 2023-24

Semester-VIII

S.N.	Category	Course Code	Course Title	Hours Per week			Total Contact Hrs. per week	Credits	Examination Schedule (Marks)			
				L	T	P			Marks of classwork	Theory	Practical	L
1.	**ESC**		MOOC–1 (Essential)	3	-	-	-	3	-	-	-	100
2.	**ESC**		MOOC–2 (Essential)	3	-	-	-	3	-	-	-	100
3.	**PROJECT**		Project–III/Industrial Training	0	0	16	16	8	150		150	300
			Total	**6**	**0**	**16**	**22**	**14**	**150**	**-**	**150**	**500**

NOTE: At the end of the 8th semester, each student has to submit the certificate of MOOCs(Essential).

3RD SEMESTER

B.Tech. (Computer Science and Engineering- Artificial Intelligence & Data Science)
Scheme of Studies/Examination w.e.f. 2023-24

Semester- III

S.No.	Category	Course Code	Course Title	Hours Per week			Total Contact Hrs per week	Credits	Examination Schedule (Marks)			
				L	T	P			Marks of classwork	Theory	Practical	Total
1.	**ESC**		Digital Electronics	3	0	0	3	3	30	70		100
2.	**PCC**		Advanced-Data Structure	3	0	0	3	3	30	70		100
3.	**PCC**		Database Management Systems with SQL	3	0	0	3	3	30	70		100
4.	**PCC**		Programming for Data Science and AI	3	0	0	3	3	30	70		100
5.	**PCC**		Artificial Intelligence	3	0	0	3	3	30	70		100
6.	**BSC**		Discrete Mathematics	3	0	0	3	3	30	70		100
7.	**LC**		Digital Electronics Lab	0	0	2	2	1	50		50	100
8.	**LC**		Advanced-Data Structure Lab	0	0	2	2	1	50		50	100
9.	**LC**		Database Management Systems Lab	0	0	2	2	1	50		50	100
10.	**LC**		Programming for Data Science & AI Lab	0	0	2	2	1	50		50	100
11.	**MC**		Constitution of India*	2	0	0	2	0	30	70		100*
			Total	**20**	**0**	**8**	**28**	**22**	**380**	**420**	**200**	**1000**

***NOTE:** The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree. However, these marks will be shown in the detailed marks certificate of the students.

DIGITAL ELECTRONICS

Semester	III				
Course code					
Category	Engineering Science courses				
Course title	Digital Electronics				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. To understand the basic theoretical concepts of digital systems like the binary system and Boolean algebra.
2. To use Boolean algebraic formulations to design digital systems. To design using combinational/sequential circuits**.**
3. To express real-life problems in logic design terminology.
4. To understand the logic of adders, subtractors and converters.

UNIT - I

FUNDAMENTALS OF DIGITAL SYSTEMS AND LOGIC FAMILIES

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems - binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes.

UNIT - II

COMBINATIONAL DIGITAL CIRCUITS

Standard representation for logic functions, K-map representation, and simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer, Decoders, Adders, Subtractors, BCD arithmetic, carry look-ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

UNIT - III

SEQUENTIAL CIRCUITS AND SYSTEMS

A 1-bit memory, the circuit properties of the Bistable latch, the clocked SR flip-flop, J-K flip-flop, T flip-flop and D flip-flop, applications of flip-flops, shift registers, applications of shift registers, serial-to-parallel converter, parallel-to-serial converter, ring counter, sequence generator, ripple

(Asynchronous) counters, synchronous counters, counters design using flip-flops, special counter IC's, asynchronous sequential counters, applications of counters**.**

UNIT - IV

A/D AND D/A CONVERTERS

Digital to analog converters: weighted resistor/converter, R-2-R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, Analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Outline the general concepts and terminology related to logic gates, logic families, combinational and sequential circuits.
CO2: Discuss the basic analog/digital components and their interconnections in logic families and circuits.
CO3: Apply different methods/techniques to design various digital circuits.
CO4: Analyse day to day problems and industrial problems for their solutions using digital circuits.
CO5: Contrast different types of digital circuits and their designing methods.
CO6: Design digital circuit for various practical problems.

TEXT AND REFERENCE BOOKS:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer Design", Pearson Education India,2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
4. Nasib Singh Gill and J B Dixit, "Digital Design and Computer Organization", University Science Press, New Delhi

DISCRETE MATHEMATICS

Semester	III				
Course code					
Category	Basic Science courses				
Course title	Discrete Mathematics				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. To understand the basic theoretical concepts of set theory, functions, and relations.
2. To understand the basic theoretical concepts of logic systems and Boolean algebra.
3.
4. To express real-life problem of basic counting techniques and recurrence relations, algebraic structures.
5. The use of graphs theory concepts in real-life examples.

UNIT - I

SET THEORY, RELATIONS, FUNCTIONS, LOGIC AND PROPOSITIONAL CALCULUS

Set Theory: Introduction to set theory, Venn diagrams, Set operations, Algebra of sets, Duality, Finite and infinite sets, Counting principles, Power sets, Partitions, and Multi sets.

Relations: Cartesian product, Representation of relations, Types of relation, Binary relation, Equivalence relations, Partitions, Partial ordering relations, POSET, Hasse diagram, Lattices and its types.

Functions: Definition, Types of functions, Bijective functions, Composition of functions, Inverse functions, recursively defined functions, Finite and infinite sets, Countable and uncountable sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem.

Logic And Propositional Calculus: Introduction, Propositions and compound propositions, Logical operations, Propositions and truth tables, Tautologies, Contradictions, Logical equivalence, Algebra of propositions, Conditional and Bi-conditional statements, The use of Quantifiers.

UNIT - II

BASIC COUNTING TECHNIQUES AND RECURRENCE RELATION

Basic Counting Techniques: Pigeon-hole principle, Permutation and Combination, the Division algorithm: Prime Numbers, The GCD: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

Recursion And Recurrence Relation: Polynomials and their evaluation, Sequences, Introduction to AP, GP and AG Series, Partial Fractions, Recurrence Relation, Linear Recurrence Relations with

Constant Coefficients, Linear Homogeneous Recurrence Relations with Constant Coefficients, Particular Solution- Homogeneous Linear Difference Equations, Non-Homogeneous Linear Difference Equations, Total Solution, solving recurrence relation using generating functions.

UNIT - III

ALGEBRAIC STRUCTURES

Definitions and examples of Algebraic Structures with one Binary Operation: Semi Groups, Monoids, Groups, Semigroups, Subgroups, Abelian groups, Cosets, Normal Subgroup, Cyclic groups, Congruence Relation and Quotient Structures, Permutation Groups, Lagrange's Theorem, Homomorphism, Isomorphism, Automorphism.

Definitions and examples of Algebraic Structures with two Binary Operation: Rings, Integral Domain, Fields; Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form

UNIT - IV

GRAPHS THEORY: Introduction to graphs and their properties, Degree, Connectivity, Path, Cycle, Directed and undirected graphs, Subgraph, Bipartite Graphs, Regular Graphs, Connected Graphs, Multigraph and Weighted graph, Homomorphic and Isomorphic graphs, cut points and bridges, Paths and circuits, shortest path algorithm for weighted graphs, Eulerian paths and circuits, Hamiltonian path and circuits, Planar Graphs, Euler's formulae, Graph Colouring.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: To solve mathematical problems based on concepts of set theory, relations, functions and lattices.
CO2: To express logical sentences in terms of quantifiers and logical connectives.
CO3: To apply basic counting techniques to solve permutation and combination problems.
CO4: To solve recurrence relations.
CO5: To classify the algebraic structure of any given mathematical problem.
CO6: To evaluate Boolean functions and simplify expressions using the properties of Boolean algebra.

TEXT AND REFERENCE BOOKS:

1. Kenneth H. Rosen, *Discrete Mathematics and its Applications*, 6th Edition, Tata McGraw Hill, 2011.
2. Satinder Bal Gupta: *A Text Book of Discrete Mathematics and Structures*, University Science Press, Delhi.
3. C. L. Liu and D. P. Mohapatra, *Elements of Discrete Mathematics A Computer Oriented Approach*, Tata McGraw Hill, 3rd Edition, 2008.
4. J.P. Trembley and R. Manohar, *Discrete Mathematical Structures with Applications to Computer Science*, Tata McGraw Hill – 13th reprint, 2012.
5. Richard Johnsonbaugh, *Discrete Mathematics*, 6th Edition, Pearson Education Asia, 2011.
6. S. Lipschutz and M. Lipson, *Discrete Mathematics*, Tata McGraw Hill, 3rd Edition, 2010.
7. B. Kolman, R. C. Busby and S. C. Ross, *Discrete Mathematical structures*, 6th Edition, PHI, 2010.

ARTIFICIAL INTELLIGENCE

Semester	III				
Course code					
Category	Professional Core Courses				
Course title	Artificial Intelligence				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. Understand the very basics and Uses of Artificial Intelligence (AI)
2. Understand the concept of Intelligent agent and its environment.
3. To provide the most fundamental knowledge to the students so that they become familiar with basic principles of AI towards problem solving, inference, knowledge representation and learning
4. Understand the logic-building methods and inferences for the knowledge representation.
5. Explore application of AI techniques in Expert systems, Neural Networks.

UNIT - I

Introduction to AI: What is AI, Turing test, History of AI, Artificial Intelligence Techniques, advantages, and limitations of AI, Impact and Examples of AI

Applications of AI by domain: Transportation, home/service robots, healthcare, education, low-resource communities, public safety and security, employment and workplace, entertainment, finance, banking and insurance.

Intelligent agent: Nature of Agents, Rationality and Rational agent with performance measures Flexibility and Intelligent agents, Task environment and its properties, Types of agents, other aspects of agents.

UNIT – II

Problem solving methods: Problem Solving Approach to Typical AI problems

Searching techniques: Uniformed search- General search Algorithm, Uniformed search Methods-Breadth first Search, Depth first search, **Informed/Heuristic search**- Generate and test, Best First search, A* Algorithm, AO* research, **Local search Algorithms**-Hill Climbing, Simulated Annealing, Genetic Algorithms, **Game as a search problem**-Minimax approach, Minimax Algorithm, Alpha beta pruning, Constraint satisfaction problems (CSP).

UNIT - III

Knowledge Representation schemes and reasoning: Approaches and issues, procedural vs declarative knowledge, Matching, conflict resolution.

Logic: Propositional logic, predicate logic, Resolution, Resolution in proportional logic and predicate logic, Clause form, unification algorithm.

Uncertain Knowledge and reasoning: Methods, Bayesian probability and belief network, Probabilistic reasoning, Forward and backward reasoning, Dempster -Shafer theory.

UNIT - IV

Planning: The Planning problem, planning with state space search, partial order planning, Hierarchical planning, conditional planning, Continuous and Multi Agent planning.

Learning: Introduction to Learning, Types of Learning: Learning by Induction, Rote Learning, Symbol Based Learning, Identification Trees, Explanation Based Learning, Transformational Analogy

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Formulate a problem and build intelligent agents.

CO2: Apply basic principles of AI in solutions that require problem solving, inference, knowledge representation and learning.

CO3: Analyze the problem and infer new knowledge using suitable knowledge representation schemes.

CO4: Develop planning and apply learning algorithms on real world problems.

CO5: Design by planning, learning and implementing advance techniques in Artificial Intelligence.

CO6: Create a real life and industrial problems related mini project.

TEXT AND REFERENCE BOOKS:

1. Artificial Intelligence 3e: A Modern Approach Paperback – By Stuart J Russell & Peter Norvig; Publisher – Pearson
2. Artificial Intelligence Third Edition by Kevin Knight, Elaine Rich, B. Nair – Mc Graw Hill
3. Artificial Intelligence Third Edition by Patrick Henry Winston – Addison-Wesley Publishing Company
4. M. Tim Jones, ―Artificial Intelligence: A Systems Approach (Computer Science)‖, Jones and Bartlett Publishers, Inc.; First Edition, 2008
5. A Classical Approach to Artificial Intelligence, M. C. Trivedi, Khanna Publishing House.
6. G. Luger, W. A. Stubblefield, “Artificial Intelligence”, Third Edition, Addison-Wesley Longman, 1998.

DATABASE MANAGEMENT SYSTEMS WITH SQL

Semester	III				
Course code					
Category	Professional Core Courses				
Course title	Database Management Systems With SQL				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. To understand the different issues involved in the design and implementation of a database system.
2. To study the physical and logical database designs, database modeling, relational, hierarchical, and network models
3. To understand and use data manipulation language to query, update, and manage a database
4. To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data Warehousing.
5. To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

UNIT - I

Database system architecture: Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML).

Data models: Entity-relationship model, network model, relational and object-oriented data models, integrity constraints, data manipulation operations.

UNIT - II

Relational query languages: Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server.

Relational database design: Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design.

Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.

UNIT - III

Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp-based schedulers, multi-version and optimistic Concurrency Control schemes, Database recovery.
Storage strategies: Indices, B-trees, hashing,

UNIT - IV

Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.
Advanced topics: Object-oriented and object-relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.

COURSE OUTCOMES:
At the end of this course, students will demonstrate the ability to

CO1: For a given query, write relational algebra expressions for that query and optimize the developed expressions
CO2: For a given requirement specification, design the databases using E R method and normalization.
CO3: For a given specification, construct the SQL queries for Open source and Commercial DBMS - MYSQL, ORACLE, and DB2.
CO4: For a given query, optimize its execution using Query optimization algorithms
CO5: For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.
CO6: Implement the isolation property, including locking, and time stamping based on concurrency control and Serializability of scheduling.

TEXT AND REFERENCE BOOKS:

1. Database System Concepts, 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill
2. Principles of Database and Knowledge–Base Systems, Vol 1 by J. D. Ullman, Computer Science Press.
3. Fundamentals of Database Systems, 5th Edition by R. Elmasri and S. Navathe, Pearson Education
4. Foundations of Databases, Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley

PROGRAMMING FOR DATA SCIENCE and AIML

Semester	III				
Course code					
Category	Professional Core Courses				
Course title	Programming for Data Science and AIML				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. To impart the basic concepts of Python programming.
2. To understand concepts and usage of NumPy and Pandas packages for numerical data calculations in Python.
3. To understand concepts and applications of various data visualization tools of Python on real-world data.
4. To understand and implement the Machine Learning Concepts in Python.

UNIT - I

Overview of Python Programming Concepts: The concept of data types; variables, assignments; numerical types; operators and expressions; Control Structures; String manipulations; List; Tuple; Set Dictionaries; Functions.

UNIT - II

Introduction to Numpy: Creation on Array, Array generation from Uniform distribution, Random array generation, reshaping, maximum and minimum, reshaping, Arithmetic operations, Mathematical functions, Bracket Indexing and Selection, Broadcasting, Indexing a 2D array (matrices).

Data Manipulation with Pandas: Creating a Series - from lists, arrays and dictionaries; storing data in series from intrinsic sources, Creating Data Frames; Imputation, Grouping and aggregation, Merging, Joining, Concatenation, Find Null Values or Checking for Null Values, Reading data from CSV, txt, excel, web.

UNIT - III

Introduction to Visualization: Installing and setting up visualization libraries, Canvas and Axes, Subplots, Common plots – scatter, histogram, boxplot, Logarithmic scale, Placement of ticks and custom tick labels, Pandas Viz, Style Sheets, Plot type, Area, Bar plots, Histograms, Line Plots, Scatter Plots, Boxplots, Hexagonal Bin Plot, Kernel Density Estimation plot (KDE), Distribution

Plots, Categorical Data Plots, Combining Categorical Plots, Matrix Plots, Regression Plots, Grids; Python Visualizations toolkits/libraries.

UNIT - IV

Introduction to Machine Learning with SciKit-Learn & PyTorch: Overview of Python ML/Deep Learning toolkits/Libraries; types of machine learning algorithms: supervised, unsupervised and reinforcement learning.

Introduction to NLP with NLTK and its functions, modules like speech tagging, tokenization, parsing, segmentation, recognition, cleaning & normalization of text etc.; Overview of other Python NLP toolkits/Libraries.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Understand and implement the basics of programming in Python.
CO2: Apply the Numpy package for numerical calculations in Python.
CO3: Apply the Pandas package for loading and preprocessing data in Python.
CO4: Implement various data visualization tools of Python on real-world data.
CO5: Understand and implement the Machine Learning Concepts in Python.
CO6: Analyse day-to-day problems and industrial problems for their solutions using machine learning and data science techniques.

TEXT AND REFERENCE BOOKS:

1. Charles Dierbach, Introduction to Python using Computer Science, Wiley Publications, Second Edition, 2015
2. Mark Lutz, Learning Python, O'Reilly publications, Fifth Edition, 2015
3. Jake Vandar Plas, Python Data Science Handbook, O'Reilly, 2016
4. Paul Barry, Head First Python, O'Reilly y Publications, Second Edition, 2010

Reference Websites: (nptel, swayam, coursera, edx, udemy, official documentation weblink)

1. https://swayam.gov.in/nd1_noc19_cs59/preview
2. https://www.python.org/
3. https://www.datacamp.com/

ADVANCE DATA STRUCTURE

Semester	III				
Course code					
Category	Professional Core Courses				
Course title	Advance Data Structure				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. To understand and apply linear data structures-List, Stack and Queue.
2. To understand the tree algorithms and their applications.
3. To learn different algorithms and analysis techniques.
4. To apply sorting algorithms in real-time applications

UNIT - I

Review of Linear Data Structures

Linked List: Traverse, Insertion, Deletion; Circular List: Traverse, Insertion, Deletion, Doubly List and Circular List: Insertion and deletions; Stacks and Queue implementation using linked list.

Introduction to Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries.

Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, and Extendible Hashing.

UNIT - II

Advanced Trees: Trees: Review of binary trees and binary search trees: traversing, insertion, and deletion; **AVL Trees:** Introduction to AVL trees, Rotations in AVL trees: LL, RR, LR & RL,

Introduction, Search, Insert & delete operations: Red-Black Trees, 2-3 Trees, B-Trees, B+ Trees, Splay Trees.

UNIT - III

Sets: Representation on Sets, Operations on Sets, Application on Sets,

Files: File Concepts, File organization, Files and Streams, Working with Files Using I/O Stream, Sequential File Organization, Direct File Organization, Indexed Sequential Organization

UNIT - IV

Graphs: Representation, Basic terminology, traversal, connected components, shortest path, topological sort, Dijkstra's Algorithm, Floyd Warshall's Algorithm, network flow problems.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Design and Analyze programming problem statements.
CO2: Understand the ADT/libraries, and use it to design algorithms for a specific problem.
CO3: Select algorithm design approaches in a problem-specific manner.
CO4: Compare & contrast the complexity analysis of various sorting & searching algorithms.
CO5: To be able to analyse the efficiency of algorithms.
CO6: Implement various data structure concepts on real-world industrial problems.

TEXT AND REFERENCE BOOKS:

1. Seymour Lipschutz: Data Structures with C, Schaum's outline by TMH
2. E Horowitz and S. Sahni: Fundamentals of Data Structures in C, Second Edition, Universities Press, Hyderabad.
3. R.B. Patel: Expert Data Structures in C, Khanna Publishers,2001.
4. R.L. Kruse: Data Structures & Program Design in C, PHI.
5. D.F. Knuth: The art of Computer Programming Vol 1, Narosa Publications,1985.
6. Byron S. Gottfried & J K Chhabra: Theory and Problems of Programming with C Language, Schaum's Series, TMH,2005.

CONSTITUTION OF INDIA

Semester	III				
Course code					
Category	Mandatory courses				
Course title	Constitution of India				
Scheme and Credits	L	T	P	Credits	
	2	0	0	-	
Classwork	30				
Exam	70				
Total	100				
Duration of Exam	3				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.
4. To learn procedure and effects of emergency, composition and activities of election commission and amendment procedure.

UNIT - I

Philosophy of Indian Constitution: Salient features of Indian Constitution, Preamble, and Nature of Indian Constitution, Procedure for amendment of the Constitution.

UNIT - II

Federal structure and distribution of legislative and financial powers between the Union and the States

UNIT - III

Organs of Governance: President – Qualification and Powers of the President, Governor- Qualification and Powers of Governor,

Parliament: Composition, Qualifications and Disqualifications, Judiciary: Appointment, Tenure and Removal of Judges.

UNIT - IV

Fundamental Rights: Origin and development of Fundamental rights, Need for fundamental rights. Introduction to Rights to equality, right to freedom, right against exploitation, Right to freedom of religion, Cultural and Education rights and Fundamental duties.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2: Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to a revolution in India.

CO3: Exercise his fundamental rights in proper sense at the same time identifies his responsibilities in national building.

CO4: Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

CO5: Discuss the passage of the Hindu Code Bill of 1956.

CO6: Analyse the Indian political system, the powers and functions of the Union, State and Local Governments in detail.

TEXT AND REFERENCE BOOKS:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S.N. Busi, Dr. B.R. Ambedkar framing of Indian Constitution, latest Edition
3. M.P. Jain, Indian Constitution Law, Lexis Nexis, latest edition
4. D.D. Basu, Introduction to Constitution of India, Lexis Nexis, latest edition.

NOTE: The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree. However, these marks will be shown in the detailed marks certificate of the students.

DIGITAL ELECTRONICS LAB

Semester	III				
Course code					
Category	Laboratory course				
Course title	Digital Electronics Lab				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Classwork	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	02 Hours				

Note:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

CONTENTS

Implementation of all experiments with the help of Bread-Board.

1. Study of Logic Gates: Truth-table verification of OR, AND, NOT, XOR, NAND and NOR gates; Realization of OR, AND, NOT and XOR functions using universal gates.
2. Half Adder / Full Adder: Realization using basic and XOR gates.
3. Half Subtractor / Full Subtractor: Realization using NAND gates.
4. 4-Bit Binary-to-Gray & Gray-to-Binary Code Converter: Realization using XOR gates.
5. 4-Bit and 8-Bit Comparator: Implementation using IC7485 magnitude comparator chips.
6. Multiplexer: Truth-table verification and realization of Half adder and Full adder.
7. Demultiplexer: Truth-table verification and realization of Half subtractor and Full subtractor.
8. Flip Flops: Truth-table verification of JK Master Slave FF, T-type and D-type FF.
9. Asynchronous Counter: Realization of 4-bit up counter and Mod-N counter.
10. Synchronous Counter: Realization of 4-bit up/down counter and Mod-N counter.
11. Shift Register: Study of shift right, SIPO, SISO, PIPO, PISO & Shift left operations.
12. DAC Operation: Study of 8-bit DAC, obtain staircase waveform.
13. ADC Operations: Study of 8-bit ADC

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Define different types of logic gates, identify their ICs and also verify their truth table.

CO2: Derive basic logic gates, adder, and subtractor using universal gates.

CO3: Illustrate realization of Boolean expression in SOP and POS form and design it using logic gates.

CO4: Design and test combinational circuits.

CO5: Design and develop sequential circuits.

CO6: Demonstrate team-based laboratory activities with fellow students to interact effectively on a social and interpersonal level.

DATABASE MANAGEMENT SYSTEM LAB

Semester	III				
Course code					
Category	Laboratory course				
Course title	Database Management System Lab				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Classwork	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	02 Hours				

Note:

(iii) At least 10 experiments are to be performed by students in the semester.

(iv) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

CONTENTS

1. Design a Database and create required tables. For e.g. Bank, College Database
2. Apply the constraints like Primary Key, Foreign key, NOT NULL to the tables.
3. Write a SQL statement for implementing ALTER, UPDATE and DELETE.
4. Write the queries to implement the joins.
5. Write the query for implementing the following functions: MAX (), MIN (), AVG () and COUNT ().
6. Write the query to implement the concept of Integrity constrains.
7. Write the query to create the views.
8. Perform the queries for triggers.
9. Study of PL/SQL block.
10. Write a PL/SQL block to satisfy some conditions by accepting input from the user.
11. Write the query for creating the users and their role. Mini project (Application Development using Oracle/ MySQL)
    a. Inventory Control System
    b. Material Requirement Processing.
    c. Hospital Management System.
    d. Railway Reservation System.
    e. Personal Information System.
    f. Web-Based User Identification System.
    g. Time Table Management System.
    h. Hotel Management

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Identify the fundamental elements of relational database management systems.

CO2: Design and explain the basic concepts of relational data model, entity-relationship model, and relational database design.

CO3: Apply the relational database theory to formulate basic and advanced SQL queries and relational algebra expressions for the queries.

CO4: Identify the use of normalization and functional dependency in database design.

CO5: Understand the concept of transactions and serializability in database management system.

CO6: Classify the implementation details of Concurrency control protocols and discuss various database recovery methods.

ADVANCED DATA STRUCTURE LAB

Semester	III				
Course code					
Category	Laboratory course				
Course title	Advance Data Structure Lab				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Classwork	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	02 Hours				

Note:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

CONTENTS

1. Write a program to implement all operations on 1-D array.
2. Write a program to implement all operations on Simple Linked List.
3. Write a program to implement all operations on a circular Linked List.
4. Write a program to implement all operations on a doubly Linked List.
5. Write a program to implement all operations on a doubly circular Linked List.
6. Write a program to implement all operations on Stack using Array.
7. Write a program to implement all operations on Stack using Linked List.
8. Write a program to implement all operations on Queue using Array.
9. Write a program to implement all operations on Queue using Linked List.
10. Write a Program to implement dictionary techniques.
11. Write a program to implement hashing techniques.
12. Write a Program to implement Red-Black Trees.
13. Write a Program to implement Binary Search Trees.
14. Write a Program to design a menu to implement: Quick, Merge, and Bubble sorting.
15. Write a Program to develop a recursive Program to implement Breadth First Search and Depth First Search.
16. Write a Program to develop a non-recursive Program to implement Breadth First Search and Depth First Search

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Identify the appropriate data structure for a given problem.

CO2: Implement Dictionary by using hashing techniques.

CO3: Analyse various basic operations of trees to improve the efficiency.

CO4: Build a Binary Heap using Priority queues.

CO5: Apply the concepts of data structures in various real-world applications.

CO6: Identify, model, solve and develop algorithms for real-life problems like shortest path and MST using graph theory.

PROGRAMMING FOR DATA SCIENCE AND AIML LAB

Semester	III				
Course code					
Category	Laboratory course				
Course title	Programming for Data Science and AIML Lab				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Classwork	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	02 Hours				

CONTENTS

1. Python program to display details about the operating system, working directory, files And directories in the current directory, lists the files and all directories, scan and classify them as directories and files
2. Python program to convert an array to an array of machine values and vice versa
3. Python program to get information about the file pertaining to the file mode and to get time values with components using local time and gm time.
4. Python program to connect to Google using socket programming
5. Python program to perform Array operations using Numpy package
6. Python program to perform Data Manipulation operations using Pandas package.
7. Python program to display multiple types of charts using Matplotlib package
8. Python program to perform File Operation on Excel Data Set
9. Python program to implement with Python Sci Kit-Learn & NLTK.
10. Python program to implement with Python NLTK/Spicy/Py NLPI.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Explain usage of List, Tuples, Set, Dictionary and Strings and use these to solve programming problems in different ways.

CO2: Understand various built-in python functions and formulate user-defined functions.

CO3: Apply the Numpy package for numerical calculations in Python.

CO4: Apply the Pandas package for loading and preprocessing data in Python.

CO5: Implement various data visualization tools of Python on real-world data.

CO6: Understand and implement the Machine Learning Concepts in Python.

4TH SEMESTER

B.Tech. (Computer Science and Engineering- Artificial Intelligence & Data Science)
Scheme of Studies/Examination w.e.f. 2023-24

Semester- IV

S.N.	Category	Course Code	Course Title	Hours Per week			Total Contact Hrs. per week	Credits	Examination Schedule(Marks)			
				L	T	P			Marksof classwork	Theory	Practical	Total
1.	**PCC**		Operating System	3	0	0	3	3	30	70		100
2.	**ESC**		R-Programming	3	0	0	3	3	30	70		100
3.	**PCC**		Programmingin Java	3	0	0	3	3	30	70		100
4.	**PCC**		Design & Analysis of Algorithms	3	0	0	3	3	30	70		100
5.	**PCC**		Computer Organization & Architecture	3	0	0	3	3	30	70		100
6.	**PCC**		Computer Networks	3	0	0	3	3	30	70		100
7.	**LC**		Operating System Lab	0	0	2	2	1	50		50	100
8.	**LC**		Programming in Java Lab	0	0	2	2	1	50		50	100
9.	**LC**		Design & Analysis of Algorithms Lab	0	0	2	2	1	50		50	100
10.	**LC**		R-Programming Lab	0	0	2	2	1	50		50	100
			Total	**18**	**0**	**8**	**26**	**22**	**380**	**420**	**200**	**1000**

NOTE: At the end of 4th semester each student as to undergo Practical Training of 4/6 weeks in an Industry /Institute/ Professional Organization/Research Laboratory/training centre etc. and submit the typed report along with a certificate from the organization & its evaluation shall be carried out in the 5th Semester.

OPERATING SYSTEM

Semester	IV				
Course code					
Category	Professional Core Courses				
Course title	Operating System				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. To understand the mechanisms of OS to handle processes and threads and their communication.
2. To understand the process management mechanisms and scheduling algorithms.
3. To understand the mechanisms involved in memory management in OS and virtual memory concepts.
4. To understand the file management and deadlocks handling techniques in OS.

UNIT - I

Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services.

Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching. Thread: Definition, Various states, Benefits of threads, Types of threads, Multithreading.

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non-pre-emptive, FCFS, SJF, SRTF, RR Scheduling.

UNIT - II

Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, The Producer\ Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.

Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, and Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

UNIT - III

Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation

and Compaction; Paging: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging.

Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Optimal Page Replacement and Least Recently used (LRU).

UNIT - IV

File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), efficiency and performance.

Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks. Case study on UNIX and WINDOWS Operating System.

Case Studies: Comparative study of WINDOW, UNIX & LINUX system.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Explain the basic concepts of operating system.
CO2: Describe mechanisms of OS to handle processes, threads, and their communication.
CO3: Analyze the memory management and its allocation policies.
CO4: Illustrate different conditions for deadlock and their possible solutions.
CO5: Discuss the storage management policies with respect to different storage management technologies.
CO6: Evaluate the concept of the operating system with respect to UNIX, Linux, Time, and mobile OS.

TEXT AND REFERENCE BOOKS:

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.
3. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
4. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley
5. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India
6. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates

R - PROGRAMMING

Semester	IV				
Course code					
Category	Engineering Science courses				
Course title	R - Programming				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVES:

1. Learn Fundamentals of R.
2. Covers how to use different functions in R, how to read data into R, accessing R packages, writing R functions, debugging, and organizing data using R functions.
3. Cover the Basics of statistical data analysis with examples.
4. The whole syllabus will give an idea to collect, compile and visualize data using statistical functions.

UNIT - I

Introduction to R: What is R? – Why R? – Advantages of R over Other Programming Languages - R Studio: R command Prompt, R script file, comments.

Handling Packages in R: Installing a R Package, Few commands to get started: installed.packages(), package.Description(), help(), find.package(), library() - Input and Output – Entering Data from keyboard.

R - Data Types: Vectors, Lists, Matrices, Arrays, Factors, Data Frame.

R - Variables: Variable assignment, Data types of Variable, Finding Variable ls(), Deleting Variables

UNIT - II

R - Operators: Arithmetic Operators, Relational Operators, Logical Operator, Assignment Operators, Miscellaneous Operators.

R - Decision Making: if statement, if – else statement, if – else if statement, switch statement.

R - Loops: repeat loop, while loop, for loop - Loop control statement: break statement, next statement.

R - Function: function definition,Built-inn functions: mean(), paste(), sum(), min(), max(), seq(), user-defined function, calling a function, calling a function without an argument, calling a function with argument values.

UNIT - III

R – Strings: Manipulating Text in Data: substr(), strsplit(), paste(), grep(), toupper(), tolower().
R – Vectors: Sequence vector, rep function, vector access, vector names, vector math, vector recycling, vector element sorting.
R – List: Creating a List, List Tags and Values, Add/Delete Element to or from a List, Size of List, Merging Lists, Converting List to Vector.
R – Matrices: Accessing Elements of a Matrix, Matrix Computations: Addition, subtraction, Multiplication and Division.
R - Arrays: Naming Columns and Rows, Accessing Array Elements, Manipulating Array Elements, Calculation Across Array Elements.
R – Factors: creating factors, generating factor levels gl().
R - Data Frames: Create Data Frame, Data Frame Access, Understanding Data in Data Frames: dim(), nrow(), ncol(), str(), Summary(), names(), head(), tail(), edit() functions - Extract Data from Data Frame, **Expand Data Frame:** Add Column, Add Row - Joining columns and rows in a Data frame rbind() and cbind() – Merging Data frames merge() – Melting and Casting data melt(), cast().

UNIT - IV

Loading and handling Data in R: Getting and Setting the Working Directory – getwd(), setwd(), dir() - R-CSV Files - Input as a CSV file, Reading a CSV File, Analyzing the CSV File: summary(), min(), max(), range(), mean(), median(), apply() - Writing into a CSV File – R -Excel File – Reading the Excel file.
Data Visualization through various plots and charts: bar charts, histogram, frequency polygon, density plots, scatter plots, box & whisker plots, heat and contour plots, plotting the above graphs in R, plotting with package ggplot2.

COURSE OUTCOMES:
At the end of this course, students will demonstrate the ability to
CO1: outline concepts related to R programming and data analysis.
CO2: explain the basic concepts and tools that are used to solve problems in data analytics.
CO3: apply R programming for reading, cleaning, visualizing and analysing data.
CO4: analyse the trends in data through exploratory data analysis.
CO5: Understands the loading, retrieval techniques of data.
CO6: Minimize and maximize functions simulation and visualization and statistical analysis using R.

TEXT AND REFERENCE BOOKS:

1. W. N. Venables, D. M. Smith and the R core Team, An introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics, version 3.3.2, 2016.
2. Saroj Dahiya Ratnoo and Himmat Singh Ratnoo, Essentials of R for Data Analytics, Wiley, 2021.
3. Hadley Wickham and Garrett Grolemund, R for Data Science Import, Tidy, Transform and model Data, O'Reilly, 2017.
4. Paul Teeter, R Cookbook, O'Reilly, 2011.
5. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning with Applications in R, Springer, 2013.
6. Han, J., Kamber, M, Pei, J., Data Mining Concepts and Techniques, Third edition, Morgan Kaufmann, 2012.

PROGRAMMING IN JAVA

Semester	IV				
Course code					
Category	Professional Core Courses				
Course title	Programming in Java				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. Gain knowledge about basic Java language syntax and semantics to write Java programs and use concepts such as variables, conditional and iterative execution methos etc.
2. Be able to use the Java SDK environment to create, debug and run simple Java programs.
3. To analyze the object-oriented paradigm using java programming language.
4. To implement small/medium scale java programs to resolve small business problems.

UNIT - I

Introduction to Java: Evolution of Java, Object Oriented Programming Structure, Overview and characteristics of Java, Java program Compilation and Execution Process, Organization of the Java Virtual Machine, Client side Programming, Platform Independency & Portability, Security, Relation b/w JVM, JRE and JDK, Introduction to JAR format, Naming Conventions, Data types & Type casting, operators, Security Promises of the JVM, Security Architecture and Security Policy, security aspects, sandbox model.

UNIT - II

OOPS Implementation: Classes, Objects, attributes, methods, data encapsulation, reference variables, Constructors, Anonymous block, Method Overloading, Static Data members, Block & methods; Memory Structure: Stack, Heap, Class & Method area

Class loading & Execution flow: Static vs Dynamic Class loading, implicit vs explicit class loading, class loading operations;

Argument Passing Mechanism: Passing primitive arguments, passing objects, Wrapper Classes;

This keyword: Referencing instance members, Intra class constructor chaining, Method chaining;

Inheritance & code reusability: Extending classes for code reusability, Usage of super keyword, Method Overriding, Object class

Inheritance & Runtime Polymorphism: Static & Dynamic binding, Inheritance and Is-A relation, Runtime Polymorphism and Generalization, Abstract classes & methods, Final Keyword;

Interfaces and Role based Inheritance: Feature & Role based Inheritance, Static & Dynamic classing Environment, classes & interfaces, interface applications in real scenarios; Has-A relation: Aggregation & Composition, Nested classes, Inner classes, Anonymous Inner classes, String Buffer Class, tokenizer, applets, Life cycle of applet and Security concern

UNIT - III

Threads: Creating Threads, Thread Priority, Blocked States, Extending Thread Class, Runnable Interface, Starting Threads, Thread Synchronization, Synchronize Threads, Sync Code Block, Overriding Synced Methods, Thread Communication, wait, notify and notify all.

Swing & AWT:

Swing class hierarchy, containers, user interface components, graphics context, AWT Components, Component Class, Container Class, Layout Manager Interface Default Layouts, Insets and Dimensions, Border Layout, Flow Layout, Grid Layout, Card Layout Grid Bag Layout AWT Events, Event Models, Listeners, Class Listener, Adapters, Action Event Methods Focus Event Key Event, Mouse Events, Window Event

Package & Scopes: Need of Packages, associating classes to Packages, Class path environment variable, Import Keyword and Feature of static import, Public, protected, private & default scope, Private Inheritance;

Exception Handling: exception and error, Exception Handling & Robustness, Common Exceptions and Errors, Try and catch block, Exception handlers, throw keyword, Checked and Unchecked Exceptions, Role of finally, User defined Exceptions.

UNIT - IV

Collection Framework: Role and Importance of Collection Framework, List & Set based collection, Iterator & List Iterator, Maps, Searching elements in List, Hash and Tree based collections, Role of equals and hashCode() methods, Comparable and Comparator Interfaces, Thread Safety and Vector, Difference b/w Enumeration and Iterator, Type safety and Generics, Common algorithms and Collections class, Using Properties class for managing properties files;

Database Connectivity Using JDBC: Overview of native and ODBC Drives, Introduction to JDBC, Type of JDBC drivers, Usage of drivers, defining properties-based Connection Factory; Basic database operations: Insert, Delete, Update, and Select;

Prepared Statement: Statement, Prepared Statement, Setting Query parameters, Executing Queries;

Callable Statement: Creating PL/SQL Stored procedures and functions, Creating Callable statements, executing procedures & functions, Batch Updation, Transacting Queries, Programmatic initialization of database, ResultSetMetaData, DatabaseMetaData; Input/Output Stream, Stream Filters, Buffered Streams, Data input and Output Stream, Print Stream Random Access File,

Reflection: reflection API, newInstance()method, javap tool, creating javap tool, creating applet viewer, call private method, java 9 features.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Identify classes, objects, members of a class and relationships among them for a specific problem.

CO2: Understand and demonstrate the concepts of garbage collection, polymorphism, inheritance etc.

CO3: Do numeric (algebraic) and string-based computation.

CO4: Understand and implement modularity as well as basic error-handling techniques.

CO5: Develop, design and implement small multithreaded programs using Java language.

CO6: Apply appropriate problem-solving strategies for the implementation of small/medium scale Java applications.

TEXT AND REFERENCE BOOKS:

1. E. Balaguruswamy, “Programming with Java”, TMH
2. Horstmann, “Computing Concepts with Java 2 Essentials”, John Wiley.
3. Decker &Hirshfield, “Programming.Java”, Vikas Publication.
4. Patrick Naughton and HerbertzSchidt, “Java-2 the complete Reference”, TMH
5. Sierra & bates, “Head First Java”, O’Reilly.

DESIGN AND ANALYSIS OF ALGORITHMS

Semester	IV				
Course code					
Category	Professional Core Courses				
Course title	Design & Analysis of Algorithms				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. Analyze the asymptotic performance of algorithms.
2. Write rigorous correctness proofs for algorithms.
3. Demonstrate a familiarity with major algorithms and data structures.
4. Apply important algorithmic design paradigms and methods of analysis.
5. Synthesize efficient algorithms in common engineering design situations.

UNIT - I

Introduction to Algorithms: Algorithm, Performance Analysis (Time and Space complexity), Asymptotic Notation (Big O, Omega and Theta)-best, average and worst-case behaviour. Elementary Data Structures (Basic terminology of Stacks and Queues, Tree, Graph), Sets and Disjoint Set Union.

Divide and Conquer: General method, Binary Search, Merge Sort, Quick Sort, and other sorting algorithms with divide and conquer strategy, Strassen's Matrix Multiplication algorithms and analysis of these problems.

UNIT - II

Greedy Method: General method, Fractional Knapsack problem, Job Sequencing with Deadlines, Minimum Cost Spanning Trees, Single source shortest paths.

Dynamic Programming: General method, Optimal Binary Search Trees, 0/1 knapsack, The Traveling Salesperson problem.

UNIT - III

Back Tracking: General method, The 8-Queen's problem, Sum of subsets, Graph Colouring, Hamiltonian Cycles.

Branch and Bound: The method, 0/1 knapsack problem, Traveling Salesperson problem, Efficiency considerations.

UNIT - IV

NP Hard and NP Complete Problems: Basic concepts, Cook's theorem, NP hard graph problems, NP hard scheduling problems, NP hard code generation problems, and Some simplified NP hard problems.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: state terminology and concepts algorithmic techniques.
CO2: discuss various algorithmic techniques.
CO3: apply appropriate algorithmic techniques to solve computational problems.
CO4: analysing algorithms for their efficiency by determining their complexity.
CO5: compare the pros and cons of applying the different algorithmic techniques to solve problems.
CO6: formulate efficient and effective algorithmic solutions for different real- world problems.

TEXT AND REFERENCE BOOKS:

1. Fundamental of Computer algorithms, Ellis Horowitz and Sartaj Sahni, 1978, Galgotia Publication
2. Introduction to Algorithms, Thomas H Cormen, Charles E Leiserson and Ronald L Rivest: 1990, TMH
3. The Design and Analysis of Computer Algorithm, Aho A.V. Hopcroft J.E., 1974, Addison Wesley.
4. Algorithms-The Construction, Proof and Analysis of Programs, Berlion, P.Bizard, P., 1986. Johan Wiley & Sons,
5. Writing Efficient Programs, Bentley, J.L., PHI
6. Introduction to Design and Analysis of Algorithm, Goodman, S.E. &Hedetnieni, 1997, MGH.
7. Introduction to Computers Science- An algorithms approach, Jean Paul Trembley, Richard B.Bunt, 2002, T.M.H.
8. Fundamentals of Algorithms: The Art of Computer Programming Vol Knuth, D.E.: 1985, Naresh Publication.

COMPUTER ORGANIZATION AND ARCHITECTURE

Semester	IV				
Course code					
Category	Professional Core Courses				
Course title	Computer Organization and Architecture				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. How Computer Systems work & the basic principles.
2. Instruction Level Architecture and Instruction Execution.
3. The current state of art in memory system design.
4. How I/O devices are accessed and its principles.
5. To provide the knowledge on Instruction Level Parallelism.
6. To impart the knowledge on microprogramming.
7. Concepts of advanced pipelining techniques.

UNIT - I

Data representation: Data Types, Complements, Fixed-Point Representation, Conversion of Fractions, Floating-Point Representation, Gray codes, Decimal codes, Alphanumeric codes, Error Detection Codes.

Register Transfer and Microoperations: Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Microoperations, Logic Microoperations, Shift Microoperations, Arithmetic Logic Shift Unit.

UNIT - II

Basic Computer Organization and Design : Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference Instruction, Input-Output Instruction, Complete Computer Description, Design of Basic Computer, Design of Accumulator Logic.

Central Processing Unit : General Register Organization, Stack organization, Instruction Format, Addressing Modes, Data Transfer and Manipulation, Program Control, RISC, CISC.

UNIT - III

Pipelining: Parallel Processing, Amdahl's law, Pipelining, Arithmetic Pipeline, Instruction Pipeline, Pipeline Hazards, RISC Pipeline.

Parallel Processors: Introduction to Parallel Processors, Concurrent access to memory andCache Coherency.

Vector Processing: Vector Operations, Memory Interleaving, Supercomputers, Array Processors: Attached Array Processor, SIMD Array Processor.

UNIT - IV

Input-output Organization: I/O device interface, I/O transfers–program controlled, interrupt driven and DMA, Privileged and Non-Privileged Instructions, Software Interrupts.

Memory organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Associative Mapping, Direct Mapping, Set-Associative Mapping, Writing into Cache, Cache Initialization, Virtual Memory.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: outline the general concepts of digital electronics and computer organization and architecture.
CO2: discuss the basic components and their interfacing.
CO3: discuss the basic components and their interfacing.
CO4: analyse the effect of addressing modes on the execution time of a program.
CO5: analyse the effect of addressing modes on the execution time of a program.
CO6: Design of simple computer with different instruction sets.

TEXT AND REFERENCE BOOKS:

1. "Computer System Architecture", 3rd Edition by M.Morris Mano, Pearson.
2. "Computer Organization and Design: The Hardware/Software Interface", 5th Edition by David A. Patterson and John L. Hennessy, Elsevier.
3. "Computer Organization and Embedded Systems", 6th Edition by CarlHamacher, McGraw Hill Higher Education.
4. "Computer Architecture and Organization", 3rd Edition by John P. Hayes,WCB/McGraw-Hill
5. "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.
6. "Computer System Design and Architecture", 2nd Edition by Vincent P. Heuring andHarry F. Jordan, Pearson Education.

COMPUTER NETWORKS

Semester	IV				
Course code					
Category	Professional Core Courses				
Course title	Computer Networks				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. To develop an understanding of modern network architectures from a design and Performance perspective.
2. To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs), and Wireless LANs (WLANs).
3. To provide an opportunity to do Network programming.
4. To provide WLAN measurement ideas.

UNIT - I

Introduction: Data communication, Components, Data Representation, Simplex, Half Duplex, and Full Duplex Transmission, Modulation, Multiplexing, Computer networks, distributed processing, Internet, Topologies, Packet and circuit switching, connectionless and connection-oriented services.

Network Models: OSI model and TCP/IP Model

Physical Layer – LAN: Ethernet.

UNIT - II

Data Link Layer and Medium Access Sub Layer: MAC Addressing, Framing, Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window Protocol.

Medium Access Control: Random access, Controlled Access, and channelization protocols.

Network Layer: Logical addressing, classful and classless addressing, subnetting, Ipv4, ICMPv4, ARP, RARP and BOOTP, Ipv6, Ipv6 addressing.

UNIT - III

Network Devices: Repeater, hub, switch, router, and gateway.

Routing Algorithms: introduction to routing, Shortest Path Algorithm, Flooding, Hierarchical Routing, Link State, and Distance Vector Routing

Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), TCP connection management.

UNIT - IV

Congestion Control, Quality of Service, QoS Improving techniques.

Application Layer: Domain Name Space (DNS), EMAIL, File Transfer Protocol (FTP), HTTP, SNMP

Network Security: Firewalls, security goals, types of attack, symmetric and asymmetric key ciphers.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Explain the functions of the different layers of the OSI Protocol.

CO2: Draw the functional block diagram of wide-area networks (WANs), local area networks (LANs), and Wireless LANs (WLANs) and describe the function of each.

CO3: Identify and connect various connecting components of a computer network.

CO4: Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, and Firewalls using open-source available software and tools.

CO5: outline various models, topologies and devices of Computer Networks.

CO6: Design engineering solutions to complex problems utilizing a systems approach.

TEXT AND REFERENCE BOOKS:

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw-Hill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.
3. Computer Networks, latest Edition, Andrew S. Tanenbaum, Pearson New International Edition.
4. Internetworking with TCP/IP, Volume 1, latest Edition Douglas Comer, Prentice Hall of India.
5. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

OPERATING SYSTEM LAB

Semester	IV				
Course code					
Category	Laboratory course				
Course title	Operating System Lab				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Classwork	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	02 Hours				

Note:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

CONTENTS

1. Introduction to UNIX File System.
2. File and Directory Related Commands in UNIX.
3. Essential UNIX Commands for working in UNIX environment.
4. I/O Redirection and Piping
5. Introduction to VI Editors.
6. Introduction of Processes in UNIX
7. Communication in UNIX and AWK.
8. Introduction of the concept of Shell Scripting.
9. Decision and Iterative Statements in Shell Scripting.
10. Writing the Shall Scripts for unknown problems.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: apply commands related to vi and Emacs editors, general utilities and file systems.

CO2: write basic shell scripts and use sed commands as well as awk programming.

CO3: analyse the results of memory management and disk management commands.

CO4: evaluate solutions for different operating system problems such as scheduling, memory management and file management.

CO5: create lab record for assignments that includes problem definitions, design of solutions and conclusions.

CO6: demonstrate use of ethical practices, self-learning and team spirit.

PROGRAMMING IN JAVA LAB

Semester	IV				
Course code					
Category	Laboratory course				
Course title	Programming in Java Lab				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Classwork	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	02 Hours				

Note:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

CONTENTS

1. Create a java program to implement stack and queue concept.
2. Write a java package to show dynamic polymorphism and interfaces.
3. Write a java program to show multithreaded producer and consumer application.
4. Create a customized exception and also make use of all the5 exception keywords.
5. Convert the content of a given file into the upper-case content of the same file.
6. Develop an analog clock using applet.
7. Develop a scientific calculator using swings.
8. Create an editor like MS-word using swings.
9. Create a servlet that uses Cookies to store the number of times a user has visited your servlet.
10. Create a simple java bean having bound and constrained properties.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: implement Java programs using object-oriented concepts for problem solving.

CO2: detect syntax and logical errors in java programs.

CO3: apply exception handling for making robust JAVA code.

CO4: design java applications using File I/O and GUI.

CO5: create lab record for assignments that includes problem definitions, design of solutions and conclusions.

CO6: Able to build dynamic user interfaces using applets and Event handling in java.

DESIGN AND ANALYSIS OF ALGORITHMS LAB

Semester	IV				
Course code					
Category	Laboratory course				
Course title	Design and Analysis of Algorithms Lab				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Classwork	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	02 Hours				

Note:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

CONTENTS

1. Write a Program for iterative and recursive Binary Search.
2. Write a Program to sort a given set of elements using the Quick Sort/Merge Sort/Selection Sort method and determine the time required to sort the elements.
3. Write a Program for the implementation of the Fractional Knapsack problem using Greedy Method and 0/1 Knapsack problem using Dynamic Programming.
4. Write a Program to find the shortest path from a given vertex to other vertices in a weighted connected graph using Dijkstra's algorithm.
5. Write a Program to find the minimum cost spanning tree (MST) of a given undirected graph using Kruskal's algorithm/Prim's Algorithms.
6. Write a Program to implement the N-Queens problem using backtracking.
7. Write a Program to check whether a given graph is connected or not using the DFS method.
8. Write a program to implement the Travelling Salesman Problem (TSP).

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Develop and code program for the algorithms and analyze it to determine its computational complexity.

CO2: Identify and analyze worst-case running times of algorithms.

CO3: Model given engineering problem using graph and trees and write the corresponding algorithm to solve the problems.

CO4: Identify and apply the suitable algorithm for the given real-world problem.

CO5: Undertake problem identification, formulation and solution.

CO6: Design engineering solutions to complex problems utilising a systems approach.

R – PROGRAMMING LAB

Semester	V				
Course code					
Category	Laboratory course				
Course title	R - Programming Lab				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Classwork	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	02 Hours				

Note:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 5 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

CONTENTS

1. Download and install R-Programming environment and install basic packages using install. Packages () command in R.
2. Learn all the basics of R-Programming (Data types, Variables, Operators etc.)
3. Implement R-Loops with different examples.
4. Learn the basics of functions in R and implement with examples.
5. Implement data frames in R. Write a program to join columns and rows in a data frame using cbind() and rbind() in R.
6. Implement different String Manipulation functions in R.
7. Implement different data structures in R (Vectors, Lists, Data Frames)**.**
8. Write a program to read a csv file and analyze the data in the file in R**.**
9. Create pie charts and bar charts using R.
10. Create a data set and do statistical analysis on the data using R.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Show the installation of R Programming Environment.

CO2: Utilize and R Data types for developing programs.

CO3: Make use of different R Data Structures.

CO4: Develop programming logic using R Packages.

CO5: Analyze the datasets using R programming capabilities.

CO6: Apply R programming for reading, cleaning, visualizing and analyzing data.

5TH SEMESTER

B.Tech. (Computer Science and Engineering- Artificial Intelligence & Data Science)
Scheme of Studies/Examination w.e.f. 2023-24

Semester- IV

S.N.	Category	Course Code	Course Title	Hours Per week			Total Contact Hrs. per week	Credits	Examination Schedule(Marks)			
				L	T	P			Marksof classwork	Theory	Practical	Total
1.	**PCC**		Operating System	3	0	0	3	3	30	70		100
2.	**ESC**		R-Programming	3	0	0	3	3	30	70		100
3.	**PCC**		Programmingin Java	3	0	0	3	3	30	70		100
4.	**PCC**		Design & Analysis of Algorithms	3	0	0	3	3	30	70		100
5.	**PCC**		Computer Organization & Architecture	3	0	0	3	3	30	70		100
6.	**PCC**		Computer Networks	3	0	0	3	3	30	70		100
7.	**LC**		Operating System Lab	0	0	2	2	1	50		50	100
8.	**LC**		Programming in Java Lab	0	0	2	2	1	50		50	100
9.	**LC**		Design & Analysis of Algorithms Lab	0	0	2	2	1	50		50	100
10.	**LC**		R-Programming Lab	0	0	2	2	1	50		50	100
			Total	**18**	**0**	**8**	**26**	**22**	**380**	**420**	**200**	**1000**

NOTE: At the end of 4th semester each student as to undergo Practical Training of 4/6 weeks in an Industry /Institute/ Professional Organization/Research Laboratory/training centre etc. and submit the typed report along with a certificate from the organization & its evaluation shall be carried out in the 5th Semester.

PREDICTIVE ANALYTICS

Semester	V				
Course code					
Category	Professional Core Courses				
Course title	Engineering Science Course				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. To provide the knowledge of various quantitative and classification predictive models based on various regression and decision tree methods.
2. To provide the knowledge to select the appropriate method for predictive analysis
3. To provide the understanding of how to search, identify, gather and pre-process data for the analysis.
4. To provide the understanding of how to formulate predictive analytics questions.

UNIT - I

Introduction: The Analytics Life Cycle, Introduction to Predictive Analytics, Matrix Notation, Basic Foundations, Model, Method and Feature Selection

Regression: Covariance, Correlation and ANOVA review; Simple Linear Regression, OLS Model Diagnostics, Dummy Variables, Multivariate Regression, OLS Assumptions, Weighted Least Squares (WLS), Generalized Linear Models (GLM).

UNIT - II

Classification Models: Introduction, Binomial Logistic Regression, Multinomial Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis.

Decision Trees: Introduction Regression Trees, Regression Tree Issues, Classification Trees, Pruning Trees, Bootstrap Aggregation (Bagging), Random Forest Models.

UNIT - III

Data Pre-Processing: Overview, Variable Types, Introduction to Data Transformations, Data Transformations: Categorical to Dummy Variables, Polynomials, Box-Cox Transformation, Log & Elasticity Models, Logit Transformation, Count Data Models, Centering, Standardization, Rank Transformations, Lagging Data (Causal Models), Data Reduction.

UNIT - IV

Variable Selection: Dimensionality Issues, Multi-Collinearity, Variable Selection Methods, Step Methods.

Dimensionality: Regularization (Penalized or Shrinkage Models, Ridge Regression, LASSO, Dimension Reduction Models, Principal Components Regression (PCR), Partial Least Squares (PLS).

Machine Learning: Machine Learning Overview, Bias vs. Variance Trade-off, Error Measures, Cross-Validation.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Ability to develop and use various quantitative and classification predictive models based on various regression and decision tree methods.

CO2: Analyse the working mechanism of data pre-processing for the model building.

CO3: Ability to select the appropriate method for predictive analysis

CO4: Ability to search, identify, gather and pre-process data for the analysis.

CO5: Ability to formulate predictive analytics questions.

TEXT AND REFERENCE BOOKS:

1. "An Introduction to Statistical Learning: with Applications in R" by James, Witten, Hastie and Tibshirani, Springer, 1st. Edition, 2013.
2. "The Elements of Statistical Learning-Data Mining, Inference, and Prediction "by Trevor Hastie, Robert Tibshirani, Jerome Friedman , Second Edition , Springer Verlag, 2009.
3. Predictive & Advanced Analytics (IBM ICE Publication)

FORMAL LANGUAGES AND AUTOMATA THEORY

Semester	V				
Course code					
Category	Professional Core Courses				
Course title	Formal Languages and Automata Theory				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. To understand basic concepts of formal languages and automata theory.
2. To study the types of Automata i.e., NFA, DFA, NFA with ϵ-transition and their interconversion methods and importance.
3. To Study formal languages of different kinds, such as regular and context-free languages. Understand the concept of grammar and its types. Removal of ambiguity and reduced form and Normal forms of grammar.
4. To develop the concepts and design of higher-level automata to accept the language not accepted by finite automata such as PDA &Turing machine.
5. To study the various properties of Turing machines and their design.

UNIT - I

Finite Automata: Introduction: Set, Power Set, Super Set, Alphabet, languages and grammars, productions and derivation, Deterministic finite automata (DFA), Non-Deterministic finite automata (NDFA), Equivalence of DFA and NDFA, Conversion of NFA to DFA, minimization of finite automata, Finite automata with ϵ- moves, Acceptability of a string by a finite Automata.

Introduction to Machines: Properties and limitations of Finite Automata, Mealy and Moore Machines, Equivalence of Mealy and Moore machines.

UNIT - II

Regular Expression: State and prove Arden's Method, Regular Expressions, Recursive definition of the regular expression, Regular expression conversion to Finite Automata, and vice versa.

Properties of regular languages: Regular language, pumping lemma for regular sets/languages, Application of regular languages.

UNIT - III

Grammars: Chomsky hierarchy of languages, Relation between different types of grammars, Context-free grammar, Derivation tree / Parse tree, Ambiguity in regular grammar and their removal,

Reduced Forms: Removal of useless symbols, null and unit productions, Normal Form: Chomsky Normal form (CNF) and Greibach Normal Form (GNF),

Push Down Automata: Introduction to PDA, Deterministic and Non-Deterministic PDA, Design of PDA: Transition table, Transition diagram and acceptability of strings by designed PDA, Pushdown automata (PDA) and equivalence with CFG.

UNIT - IV

Turing machines: The basic model for Turing machines I, Deterministic and Non- Deterministic Turing machines and their equivalence, Design of Turing Machines: Transition table, Transition diagram and acceptability of strings by a designed Turing machine. Variants of Turing machines, Halting problem of Turing machine, PCP Problem of Turing Machine, Linear Bounded Automata, TMs as enumerators.

Undecidability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice s theorem, undecidable problems about languages.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: define terminology related to the theory of computation.
CO2: explain the basic concepts and applications of Theory of Computation.
CO3: apply the principles of Theory of Computation to solve computational problems.
CO4: compare and contrast the hierarchy of grammars.
CO5: design various types of automata for given problems.
CO6: To solve various problems of applying normal form techniques, push-down automata, and Turing Machines.

TEXT AND REFERENCE BOOKS:

1. Introduction to Automata Theory, Languages, and Computation, 3nd Edition, John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Pearson Education.
2. Introduction to the Theory of Computation, Michael Sipser, 3rd edition, Cengage Learning.
3. K. L. P Mishra, N. Chandrashekaran (2003), Theory of Computer Science-Automata Languages and Computation, 2nd edition, Prentice Hall of India, India.
4. Raymond Greenlaw, H. James Hoover, Fundamentals of the Theory of Computation, Principles and Practice, Morgan Kaufmann, 1998.
5. John C. Martin: Introduction to Languages and Automata Theory, 3rd edition, Tata McGraw-Hill, 2007

BIG DATA ANALYTICS

Semester	V				
Course code					
Category	Professional Core Courses				
Course title	Big Data Analytics				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. To describe the basic concepts of Big Data characteristics and Analytics.
2. To examine the Hadoop and MapReduce framework for processing large volume of data sets and various data analysis methods.
3. To store and retrieve the data effectively using MongoDB and report generation.
4. To analyze the big data for useful business applications and familiar with the Visualization.

UNIT – I

Introduction to Big Data: Types of Digital Data-Characteristics of Data, Evolution of Big Data, Definition of Big Data, Characteristics, Applications & Challenges with Big Data, 3Vs of Big Data, Non-Definitional traits of Big Data, Big Data workflow Management, Business Intelligence vs. Big Data, Distributed file systems.

UNIT – II

Big Data Analytics: Classification of analytics, Data Science, Terminologies in Big Data, CAP Theorem.

Introduction to Hadoop: Features, Advantages, Overview of Hadoop Eco systems, Hadoop distributions, SQL vs. Hadoop, Hadoop Components, Architecture, HDFS.

UNIT – III

Map Reduce: Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression.

NoSQL: Types of Databases, Advantages, SQL vs. NoSQL, NewSQL

Mongo DB: Introduction, Features, Data types, Mongo DB Query language, CRUD operations, Arrays. Functions: Count, Sort, t – Limit, Skip, Aggregate, Map Reduce. Cursors: Indexes, Mongo Import, Mongo Export.

UNIT – IV

Cassandra: Introduction, Features, CQLData types, CQLSH, Key spaces, CRUD operations, Collections, Counter, TTL, alter commands, Import and Export, Querying System tables.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Identify the characteristics and challenges of big data analytics.

CO2: Implement the Hadoop and MapReduce framework for processing massive volume of data.

CO3: Analyze data by utilizing various statistical and data mining approaches.

CO4: Implement CRUD operations effectively using MongoDB and Report generation using Jaspersoft studio.

CO5: Explore the usage of Hadoop and its integration tools to manage Big Data and use Visualization Techniques.

CO6: Adapt adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.

TEXT AND REFERENCE BOOKS:

1. T. Erl , W.Khattak and P. Buhler., *Big Data Fundamentals, Concepts, Drivers & Techniques* (1e), The Prentice Hall Service Technology Series, 2016.
2. S. Acharya, *Big Data and Analytics*, Wiley India Pvt. Ltd., 2015
3. V. Prajapati, *Big Data Analytics with R and Hadoop*, Packt Publishing Ltd., 2013.
4. A. Holmes, *Hadoop in Practice*, (2e), Manning Publications, 2015
5. S. Ryza, *Advanced Analytics with Spark: Patterns for Learning from Data at Scale*, (2e), O'Reilly, 2017

MACHINE LEARNING AND ITS APPLICATIONS

Semester	V				
Course code					
Category	Professional Core Courses				
Course title	Machine Learning and its Applications				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. Understand the machine learning techniques.
2. Gain knowledge of linear regression models, Random Forests
3. KNN classifier Gain knowledge on the basics of probabilistic approaches like Naïve Bayes, Bayes Theorem
4. Acquire knowledge of Support Vector machines, K-means clustering techniques
5. Introduce the working principle of Artificial Neural networks

UNIT - I

Machine Learning: Definition, History, Need, Features, Classification of Machine Learning: Supervised learning, Unsupervised learning, Reinforcement Learning, Machine Learning life cycle, Applications of Machine Learning, Parametric vs. non-parametric models. Learning theory-bias/variance tradeoff, Underfitting, Overfitting, Major differences between statistical modelling and machine learning, Steps in machine learning model development, Machine learning losses, when to stop tuning machine learning models, Train, validation, and test data Cross-validation, Grid Search.

UNIT - II

Dimensionality reduction: Definition, Row vector and Column vector, how to represent a dataset, how to represent a dataset as a Matrix, Data preprocessing in Machine Learning: Feature Normalization, Mean of a data matrix, Column Standardization, Co-variance of a Data Matrix, Principal Component Analysis for Dimensionality reduction.

UNIT - III

Supervised Learning: Definition, how it works. Types of Supervised learning algorithms k - Nearest Neighbours, Naïve Bayes, Decision Trees, Naive Bayes, Linear Regression, Logistic Regression, Support Vector Machines.

UNIT - IV

Unsupervised Learning: Clustering: K-means. Ensemble Methods: Boosting, Bagging, Random Forests.
Dimensionality reduction techniques: PCA, LDA, ICA, SVD
Evaluation: Performance measurement of models in terms of accuracy, confusion matrix, precision & recall, F1-score, receiver Operating Characteristic Curve (ROC) curve and AUC, Median absolute deviation (MAD), Distribution of errors

COURSE OUTCOMES:
At the end of this course, students will demonstrate the ability to

CO1: Acquire the knowledge of machine learning model evaluation methods/measurements.
CO2: Understand different types of machine learning techniques and their applications in the real world.
CO3: Apply various mathematical models for supervised machine learning models.
CO4: Apply and evaluate the unsupervised machine learning models through various clustering algorithms.
CO5: Evaluate various machine learning algorithms through statistical learning techniques.
CO6: Apply reinforcement learning algorithms to solve real-time complex problems with an understanding of the trade-offs involved.
CO7: Design the recommendation system using natural language processing and evaluate the machine learning models through ANN.

TEXT AND REFERENCE BOOKS:

1. E. Alpaydin, Introduction to Machine Learning, (3e), PHI Learning 2015.
2. S Marsland, Chapman and Hall, Machine Learning: An Algorithmic Perspective, (2e), CRC,2014.
3. M. Bishop, Pattern Recognition and Machine Learning, (2e), Springer, 2013.
4. T. Mitchell, Machine Learning, (1e), McGraw Hill Education, 2017.
5. L.E. Sucar, Probabilistic Graphical Models: Principles and Applications (Advances in Computer Vision and Pattern Recognition), (1e), Springer, 2016

ECONOMICS FOR ENGINEERS

Semester	V				
Course code					
Category	Humanities & Social Sciences, Including Management				
Course title	Economics for Engineers				
Scheme and Credits	L	T	P	Credits	
	3	0	0	0	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. Understand how economic analysis can be applied to engineering decision-making processes.
2. Understand the implications of economic factors on engineering design, production, and operation decisions.
3. Apply economic principles to analyze and interpret the behavior of markets and industries.
4. Gain awareness of the relationship between economics and sustainable development in engineering practices.

UNIT - I

Definition of Economics- Various definitions, types of economics- Micro and Macro-Economics, nature of economic problem, Production Possibility Curve, Economic laws and their nature, Relationship between Science, Engineering, Technology and Economic Development.

Demand- Meaning of Demand, Law of Demand, Elasticity of Demand- meaning, factors effecting it, its practical application and importance.

UNIT - II

Production- Meaning of Production and factors of production, Law of variable proportions, and returns to scale, Internal external economies and diseconomies of scale. Various concepts of cost of production- Fixed cost, Variable cost, Money cost, Realcost, Accounting cost, Marginal cost, Opportunity cost. Shape of Average cost, Marginal cost, Total cost etc. in short run and long run.

UNIT - III

Market- Meaning of Market, Types of Market- Perfect Competition, Monopoly, Monopolistic Competition and Oligopoly (main features).

Supply- Supply and law of supply, Role of demand & supply in price determination and effect of changes in demand and supply on prices.

UNIT - IV

Indian Economy- Nature and characteristics of Indian economy as under developed, developing and mixed economy (brief and elementary introduction), Privatization - meaning, merits and demerits. Globalization of Indian economy - merits and demerits.
Banking- Concept of a Bank, Commercial Bank- functions, Central Bank- functions, Difference between Commercial & Central Bank.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: outline the principles of economics in general and economics in Indian context.
CO2: discuss concepts related to economics in general and particularly relevant to Indian scenario.
CO3: apply the principles of economics for solving problems related to Engineering sector.
CO4: carry out cost/benefit/, life cycle and breakeven analyses on one or more economic alternatives.
CO5: judge the issues and challenges of sustainable development.
CO6: Undertake problem identification, formulation and solution.

TEXT AND REFERENCE BOOKS:

1. Alfred William Stonier, D. C. Hague, A text book of Economic Theory, 5th edition, Longman Higher Education, 1980.
2. K. K. Dewett, M. H. Navalur, Modem Econornic Theory, S. Chand, 2006.
3. H. L. Ahuja, Modern Microeconomic: Theory and Applications, S. Chand, 2017.
4. N. Gregory Mankiw, Principles of Economics, 7th edition, South-Western College Publishing, 2013.
5. Ruddar Dutt & K. P. M. Sundhram, Indian Economy, S. Chand, 2004.
6. V. Mote, S. Paul, G. Gupta, Managerial, Economics, McGraw Hill Education, 2017.
7. Saroj Pareek, Text book of Business Economics, Neha Publishers and Distributors, 2013.
8. William McDonough and Michael Braungart, Cradle to Cradle Remaking the Way We Make Things, North Point Press, New York, 2002.
9. Sustainable Development Challenges, World Economic and Social Survey, United Nations Publication, 2013.

PREDICTIVE ANALYTICS LAB

Semester	V				
Course code					
Category	Laboratory course				
Course title	Predictive Analytics Lab				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Classwork	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	02 Hours				

Note:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 5 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

CONTENTS

1. Introduction to Python libraries used for Predictive Analytics
2. Implement Simple Linear Regression Model using different datasets.
3. Implement Multiple Linear Regression Model using different datasets.
4. Execute Linear Discreminant Analysis (LDA) and show its characteristics.
5. Execute Principal component analysis (PCA) and show its characteristics.
6. Implement Ridge regression and show its effect on dataset.
7. Program to show Cross-validation and boot strap.
8. Program to execute fitting and classification.
9. Program to execute regression trees.
10. Program to execute K-nearest neighours,
11. Program to execute K-means clustering.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Show the execution and learning of Python libraries Environment.

CO2: Make use of simple and multiple regression models.

CO3: Understand the concept of Feature selection using LDA.

CO4: Understand the concept of Dimension Reduction using PCA.

CO5: Analyze the datasets using fitting and classification.

CO6: Applying KNN and K-means clustering for data analysis.

BIG DATA ANALYTICS LAB

Semester	V				
Course code					
Category	Laboratory course				
Course title	Big Data Analytics Lab				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Classwork	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	02 Hours				

Note:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 5 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

CONTENTS

1. Installing and configuring Hadoop cluster.
2. Manipulating files in HDFS using Hadoop fs commands.
3. Hadoop File Systems: IBM GPFS, MapR-FS, Lustre, Amazon S3 etc.
4. Writing an Inverted Index MapReduce Application.
5. Distributed Cache MapReduce Design Patterns Sorting Joins.
6. Writing a streaming MapReduce job in Hadoop.
7. Big Data and R: Clustering, Simple Linear Regression, Decision Trees, Naïve Bayesian Classification**.**
8. Big Data Interactions: Big Data and Cloud: Big Data and Web Services /SOA:Big Data and Internet of Things (IoT)**.**
9. Big Data Case Study: Healthcare Data: Web Click stream Data: Social Media Data [RSS, Tweets]**.**

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: implement solutions for big data problem.

CO2: apply Hadoop ecosystem components.

CO3: analyse the results of big data algorithms.

CO4: build and maintain reliable, scalable, distributed systems.

CO5: create lab record of the lab assignments that contains problem definitions, their solutions in big data perspective and the interpretation of the results.

CO6: demonstrate ethical practices, self-learning and team spirit.

MACHINE LEARNING LAB

Semester	V				
Course code					
Category	Laboratory course				
Course title	Machine Learning and its Application Lab				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Classwork	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	02 Hours				

Note:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 5 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

CONTENTS

1. Implement program to perform automatic word analysis.
2. Two assignments related to classification algorithms and interpreting the results of these algorithms**.**
3. Two assignments related to clustering algorithms and interpreting the results of these algorithms.
4. Three assignments on designing neural networks for solving learning problems.
5. Two assignments on ranking or selecting relevant features.
6. Two assignments on linear regression and logistic regression.
7. One assignment to be done in groups.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: implement machine learning algorithms using modern machine learning tools.

CO2: analyse the trends in datasets using descriptive statistics.

CO3: apply descriptive and predictive modelling.

CO4: compare and contrast machine learning algorithms for a given problem. (Describe datasets using descriptive statistics.

CO5: create lab records of assignment by incorporating problem definitions, design of solutions, results and interpretations.

CO6: demonstrate use of ethical practices, self-learning and team spirit.

PRACTICAL TRAINING - I

Semester	V				
Course code					
Category	Practical Training (PT)				
Course title	Practical Training - I				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Classwork	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	02 Hours				

The evaluation of Practical Training - I will be based on the seminar, viva voice, and report submitted by the students.

Professional Elective Course - I

SOFTWARE ENGINEERING

Semester	V				
Course code					
Category	Professional Elective Courses				
Course title	Software Engineering				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. Be successful professionals in the field with solid fundamental knowledge of software engineering.
2. To enable students to apply a systematic application of scientific knowledge in creating and building cost-effective software solutions to business and other types of problems.
3. To make students understand different phases to make a software & study them in detail.
4. To make students understand different testing techniques for different projects, making the students understand to develop quality software, its maintenance & software reliability.
5. To make students aware about the design models & its principles (data design, component design, interface design & architectural design).

UNIT - I

Introduction:- Evolving role of software, Software Characteristics, Software crisis, Software myths, Software process, Software development Models: Waterfall Model, Prototype Model, Spiral, Model, RAD Model, Iterative Model, Incremental Model, Aspect-oriented Model, **Agile Methodology:** Pair and mob programming, high performance teams with core protocols, test driven development, behaviour driven development, continuous delivery, clean code, refactoring, extreme programming, Scrum.

UNIT - II

Requirements, Analysis & Specification:- Software Requirements engineering, Requirement Engineering Process, Requirement Engineering Tasks, Types of requirements, SRS.

System Modeling:- Data Modeling, Functional modeling and information flow: Data flow diagrams, Behavioral Modeling, The mechanics of structured analysis: Creating entity/ relationship diagram, data flow model, control flow model, the data dictionary.

UNIT - III

System Design:- Design principles, the design process; Design concepts: Abstraction, refinement, modularity, software architecture, control hierarchy, structural partitioning, data structure, software procedure, information hiding; Effective modular design: Functional independence, Cohesion,

Coupling; Design Heuristics for effective modularity, Data Design, Architecture Design, Interface Design.

Software Testing And Maintenance:- Testing terminology: error, bug/defect/fault, failure, Verification and validation, Test case design, Static testing, Dynamic testing, Black box testing, Boundary value analysis, White box testing, basis path testing, Unit testing, Integration testing, Acceptance Testing, debugging, debugging process debugging approaches. Software maintenance categories, Models.

UNIT - IV

Software Quality Models And Standards:- Quality concepts, Software Quality Assurance, SQA activities, Formal approaches to SQA; Statistical software quality assurance; CMM, The ISO 9126 Standard, Configuration Management, Software reengineering, reverse engineering, restructuring, forward engineering,

Software Project Management:- Project management concepts, Planning the software project, Software Estimations, empirical estimation COCOMO, staffing, team structures, staffing, risk analysis and management.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Understand basic concepts of software engineering, implement Software life cycle models and have knowledge of different estimation models.

CO2: Understand requirements and modelling concepts in software development.

CO3: Understand the different design principles of a software project and prepare soft testing strategies.

CO4: Understand and incorporate the Software Quality standards and build a robust software.

CO5: Undertake problem identification, formulation and solution.

CO6: Design engineering solutions to complex problems utilising a systems approach.

TEXT AND REFERENCE BOOKS:

1. Software Engineering – A Practitioner's Approach, Roger S. Pressman, 1996, MGH.
2. Fundamentals of software Engineering, Rajib Mall, PHI
3. Software Engineering by Ian sommerville, Pearson Edu., 5th edition, 1999,AW,
4. Software Engineering – David Gustafson, 2002, T.M.H
5. Software Engineering Fundamentals Oxford University, Ali Behforooz and Frederick J. Hudson1995, JW&S
6. An Integrated Approach to Software Engineering by Pankaj jalote, 1991, Narosa.

WEB TECHNOLOGY

Semester	V				
Course code					
Category	Professional Elective Courses				
Course title	Web Technology				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. Understand the basics of HTML & Style sheets.
2. Understand the basics of server-side scripting using PHP.
3. Implement web application development procedures.

UNIT - I

Introduction to HTML: The development process, Html tags and simple HTML forms, web site structure Style sheets: Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS.

UNIT - II

Introduction to PHP: Declaring variables, data types, arrays, strings, operations, expressions, control structures, functions, Reading data from web form controls like Text Boxes, radio buttons, lists etc., Handling File Uploads, Connecting to database (My SQL as reference), executing simple queries, handling results, Handling sessions and cookies. File Handling in PHP: File operations like opening, closing, reading, writing, appending, deleting etc. on text and binary files, listing directories.

UNIT - III

Client-side Scripting: Introduction to JavaScript: JavaScript language – declaring variables, scope of variables functions, event handlers (on click, on submit etc.), Document Object Model, Form validations. Simple AJAX applications.

UNIT - IV

XML : Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Well formed, using XML with application.XML, XSL and XSLT. Introduction to XSL, XML transformed simple example, XSL elements, transforming with XSLT.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Create web pages using PHP
CO2: Identify the difference between the HTML PHP and XML documents.
CO3: Identify the engineering structural design of XML and parse tree
CO4: Analyze the difference between and PHP and XML.
CO5: Undertake problem identification, formulation and solution.
CO6: Design engineering solutions to complex problems utilising a systems approach.

TEXT AND REFERENCE BOOKS:

1. "Fundamentals of the Internet and the World Wide Web", Raymond Greenlaw and Ellen Hepp, TMH , latest edition.
2. "Internet & World Wide Programming", Deitel,Deitel & Nieto, Pearson Education
3. "Complete idiots guide to java script". Aron Weiss, QUE. "Network firewalls", Kironjeet syan - New Rider Pub.

DIGITAL IMAGE PROCESSING

Semester	V				
Course code					
Category	Professional Elective Courses				
Course title	Digital Image Processing				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. To become familiar with digital image fundamentals.
2. To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
3. To learn concepts of degradation function and restoration techniques.
4. To study the image segmentation and representation techniques.
5. To become familiar with image compression and recognition method.

UNIT - I

Introduction to Image Processing: Digital Image representation, Sampling & Quantization, Steps in image Processing, Image acquisition, color image representation.

UNIT - II

Image Transformation & Filtering: Intensity transform functions, histogram processing, Spatial filtering, Fourier transforms and its properties, frequency domain filters, color models, Pseudo coloring, color transforms, Basics of Wavelet Transforms.

UNIT - III

Image Restoration: Image degradation and restoration process, Noise Models, Noise Filters, degradation function, Inverse Filtering, Homomorphism Filtering.

UNIT - IV

Image Compression: Coding redundancy, Interpixel redundancy, Psychovisual redundancy, Huffman Coding, Arithmetic coding, Lossy compression techniques, JPEG Compression.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.

CO2: Operate on images using the techniques of smoothing, sharpening and enhancement.

CO3: Understand the restoration concepts and filtering techniques.

CO4: Learn the basics of segmentation, features extraction, compression and recognition methods for colour models.

CO5: Undertake problem identification, formulation and solution.

CO6: Design engineering solutions to complex problems utilizing a systems approach.

TEXT AND REFERENCE BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods,Digital Image Processing Pearson, Third Edition,2010.
2. Anil K. Jain,Fundamentals of Digital Image Processing Pearson, 2002.
3. Kenneth R. Castleman, Digital Image Processing Pearson, 2006.
4. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Digital Image Processing using MATLAB Pearson Education, Inc., 2011.
5. D,E. Dudgeon and RM. Mersereau, Multidimensional Digital Signal Processing Prentice Hall Professional Technical Reference, 1990.
6. William K. Pratt, Digital Image Processing John Wiley, New York, 2002
7. Milan Sonka et al Image processing, analysis and machine vision Brookes/Cole, Vikas Publishing House, 2nd edition, 1999

ADVANCE JAVA PROGRAMMING

Semester	V				
Course code					
Category	Professional Elective Courses				
Course title	Advance Java Programming				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. Programming in the Java programming language,
2. Knowledge of object-oriented paradigm in the Java programming language,
3. The use of Java in a variety of technologies and on different platforms.

UNIT - I

Servlet: Servlet introduction, web terminology, servlet API, servlet Interface, generic servlet, Http servlet, servlet lifecycle, servlet with IDE (eclipse, My eclipse, Net beans), servlet request, servlet collaboration, servlet configuration, context, attribute in servlet, session technique in servlet, event and listener, servlet filter, CRUD, pagination, input output stream, annotation, single thread model, SSI;

JSP: Lifecycle of JSP, JSPAPI, scripting elements, 9Implicit Objects, directive elements, Exceptions, action elements, expression language, MVC in JSP, JSTL, custom tags, pagination, CRUD, JSTL function, formatting, XML, SQL tags.

UNIT - II

Struts: Introduction, features, models, components, struts2 architecture, action, configuration, interceptors, validation method, aware Interfaces, stuts2withI18N, zero configuration, struts2withtiles, hibernate with struts2, spring with struts2, UI tags;

Mail API: java mail introduction, methods of sending email, sending mail by Gmail, receiving email, sending attachment, receiving attachment, sending html, forwarding, deleting email.

UNIT - III

Hibernate(HB): Introduction, architecture, HB with IDE, HB Log4j, inheritance mapping, HB mapping, transaction management, HB query language, HB criteria query language, named query, HB caching, integration, HB lifecycle;

Spring: Introduction, modules, spring with IDE, dependency injection methods, spring AOP, spring Jdbc template, spring ORM, SPEL, MVC tag library, applications, spring remoting, spring OXM, spring web, security models, spring boot, spring with angular.

UNIT - IV

Android: Introduction, history & versions, architecture, building blocks, emulator, android widgets, activity and intents, android fragments, android menu, android service, SQLite, XML & JSON, android speech, multimedia, telephony, maps;

Design Pattern: java design pattern, creational, structural, behavioral, J2EE patterns, presentation layers.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Knowledge of the structure and model of the Java programming language, (knowledge).
CO2: Use the Java programming language for various programming technologies (understanding).
CO3: Develop software in the Java programming language.
CO4: Demonstrate a sound technical knowledge of their selected project topic.
CO5: Undertake problem identification, formulation and solution.
CO6: Conduct an engineering project.

TEXT AND REFERENCE BOOKS:

1. Patrick Naught on and Herbertz Schidt, “Java-2 the complete Reference”,TMH
2. Sierra & bates, “Head First Java”, O’Reilly.
3. E. Balaguruswamy, “Programming with Java”,TMH
4. Horstmann, “Computing Conceptswith Java2 Essentials”, John Wiley.
5. Decker & Hirsh field, “Programming.Java”, Vikas Publication.

DISTRIBUTED SYSTEM

Semester	V				
Course code					
Category	Professional Elective Courses				
Course title	Distributed System				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. To examine the fundamental principles of distributed systems, and provide students hands-on experience in developing distributed protocols.
2. Analyze the issues in distributed operating systems and to address these distributed systems issues in a broader sense. Emphasis will be placed on communication, process, naming, synchronization and fault tolerance.

UNIT - I

Introduction: Distributed Operating Systems Definition and goals, Hardware and Software concepts, Design issues.

Communication in Distributed System: Computer Network and Layered protocols, Message passing and related issues, synchronization, Client Server model & its implementation, remote procedure call and implementation issues, Case Studies: SUN RPC, DEC RPC

UNIT - II

Synchronization in Distributed System: Clock synchronization and related algorithms, mutual exclusion, Deadlock in distributed systems

Processes and processors in Distributed systems: Threads, system model, processor allocation, scheduling in distributed systems: Load balancing and sharing approach, fault tolerance, real time distributed systems, Process migration and related issues

UNIT - III

Distributed File systems: Introduction, features & goal of distributed file system, file models, file accessing models, file sharing semantics, file caching scheme, file replication, fault tolerance, trends in distributed file system, case study.

Distributed Shared Memory: Introduction, general architecture of DSM systems, design and implementation issues of DSM, granularity, structure of shared memory space, consistency models, replacement strategy, thrashing

UNIT - IV

Security Issues: Introduction of Security in Distributed OS, Overview of security techniques, features, Need, Access Control, Security Management

Distributed Web-based Systems: Architecture, Processes, Communication, Naming, Synchronization

Case Studies: JAVA RMI, Sun Network File System, Google Case Study

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: List the principles of distributed systems and describe the problems and challenges associated with these principles.

CO2: Understand Distributed Computing techniques, Synchronous and Processes.

CO3: Apply Shared Data access and Files concepts.

CO4: Design distributed system that fulfills requirements with regards to key distributed systems properties.

CO5: Understand Distributed File Systems and Distributed Shared Memory.

CO6: Apply Distributed web-based system and understand the importance of security in distributed system

TEXT AND REFERENCE BOOKS:

1. Distributed Operating Systems by Andrew S Tannebaum, Pearson
2. Distributed Operating Systems Concepts and Design, Pradeep K. Sinha, PHI
3. Distributed Systems: Concepts and Design by George Coulouris, Jean Dollimore, TimKindberg, Pearson
4. Distributed Computing by Sunita Mahajan & Seema Shah OXFORD
5. Distributed Systems: Principles and Paradigms by Andrew S Tanebaum, Maarten Van Steen, PHI 6. Distributed Computing, Fundamentals, Simulations and Advanced topics, 2nd Edition, HagitAttiya and Jennifer Welch, Wiley India

6TH SEMESTER

B.Tech. (Computer Science and Engineering- Artificial Intelligence & Data Science)
Scheme of Studies/Examination w.e.f. 2023-24

Semester- VI

S.N.	Category	Course Code	Course Title	Hours Per week			Total Contact Hrs. per week	Credits	Examination Schedule (Marks)			
				L	T	P			Marks of classwork	Theory	Practical	Total
1.	**PCC**		Data Science	3	0	0	3	3	30	70		100
2.	**PCC**		Statistical Computing	3	0	0	3	3	30	70		100
3.	**PCC**		Deep Learning	3	0	0	3	3	30	70		100
4.	**PEC**		Professional Elective Course - II	3	0	0	3	3	30	70		100
5.	**PEC**		Professional Elective Course - III	3	0	0	3	3	30	70		100
6.	**OEC**		Open Elective Course-II	3	0	0	3	3	30	70		100
7.	**LC**		Deep Learning Lab	0	0	2	2	1	50		50	100
8.	**LC**		Statistical Computing Lab	0	0	2	2	1	50		50	100
9.	**PROJECT**		Project-I	0	0	4	4	2	50		50	100
			Total	**18**	**0**	**8**	**26**	**22**	**330**	**420**	**150**	**900**

NOTE:

1. **At the end of the 6th semester, each student has to undergo Practical Training of 4/6 weeks in an Industry/Institute/ Professional Organization/ Research Laboratory/ training center etc. and submit the typed report along with a certificate from the organization & its evaluation shall be carried out in the 7th Semester.**
2. **Choose any one from Professional Elective Course–II & III**
3. **Choose anyone from Open Elective Course –II**

Professional Elective Course–II

1. Fuzzy Systems and Applications
2. Computer Graphics
3. Information Retrieval
4. Soft Computing
5. Compiler Design

Professional Elective Course–III

1. Network Security and Cryptography
2. Internet Technologies
3. Mobile applications development
4. Advance Database Management System
5. Cloud Computing

DATA SCIENCE

Semester	VI				
Course code					
Category	Professional Core Courses				
Course title	Data Science				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. Utilize EDA, inference and regression techniques.
2. Utilize Matrix decomposition techniques to perform data analysis.
3. Apply data pre-processing techniques.
4. Apply Basic Machine Learning Algorithms.

UNIT-I

Introduction to data analysis: Introduction and importance of data science, Big Data Analytics, Business intelligence vs Big data, big data frameworks, Current landscape of analytics, Exploratory Data Analysis (EDA), statistical measures, Basic tools (plots, graphs and summary statistics) of EDA, Data Analytics Lifecycle, Discovery, Data Visualization Principles of Data Visualization. Motivation for using Python for Data Analysis, Introduction of Python shell iPython and Jupyter Notebook. **Essential Python Libraries:** NumPy, pandas, matplotlib, SciPy, scikit-learn

UNIT-II

Introductory hypothesis testing and statistical inference: Introduction to Hypothesis Testing, Central Limit Theorem, A/B testing. Identifying Potential Data Sources, EDA case study, testing hypotheses on means, proportions and variances Linear regression - Introduction to simple linear regression, multiple linear regression, least squares principle, exploratory vs. inferential viewpoints, Model generalizability, cross validation, and using categorical variables in regression, logistic regression, Multiple correlation, Partial correlation

UNIT– III

Linear Algebra Basics- Matrices to represent relations between data, Linear algebraic operations on matrices – Matrix decomposition: Singular Value Decomposition (SVD) and Principal Component Analysis (PCA).

Data Visualization matplotlib: Basics of matplotlib, plotting with pandas and seaborn, and other Python visualization tools

UNIT– IV

Data Pre-processing and Feature Selection - Data cleaning - Data integration - Data Reduction - Data Transformation and Data Discretization, Hierarchical Indexing, Combining and Merging Data Sets Reshaping and Pivoting. Feature Generation and Feature Selection, Feature Selection algorithms: Filters- Wrappers - Decision Trees - Random Forests

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Understand the fundamentals of data science, big data, and Exploratory Data Analysis (EDA) tools.

CO2: Apply hypothesis testing, statistical inference, and linear regression techniques to real-world data.

CO3: Understand linear algebra concepts like matrix operations, SVD, and PCA for data analysis.

CO4: Perform data pre-processing, feature generation, and feature selection using various algorithms.

CO5: Design and implement effective data visualizations using Python tools like matplotlib and seaborn.

TEXT AND REFERENCE BOOKS:

1. Mining of Massive Datasets. v2.1, Jure Leskovek, Anand Rajaraman and Jefrey Ullman., Cambridge University Press. (2019)
2. Doing Data Science, Straight Talk From The Frontline, Cathy O'Neil and Rachel Schutt, O'Reilly
3. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython Wes McKinney, O'Reilly Media
4. Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, AurélienGéron, O'Reilly Media.

STATISTICAL COMPUTING

Semester	VI				
Course code					
Category	Professional Core Courses				
Course title	Statistical Computing				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. Understand the basics of data, exploratory data analysis, statistics.
2. Demonstrate the concept of hypothesis testing in problem-solving.
3. Illustrate multivariate data analysis methods to solve the problems.
4. Understand the concepts of classification methods to analysis and representation of multivariate data in real world.

UNIT - I

Review of Descriptive Statistics and Probability Theory: Scale of measurement and data types, Descriptive statistics, Frequency Tables and graphs, Relative frequency tables and graphs, grouping data, histograms and ogive, mean, median, mode, variance and standard deviation of sample data, Sample spaces and events, Axioms, Conditional Probability, Independent event, Bayes Theorem, Binomial Theorem.

UNIT - II

Random Variable and Distributions: Random variables, type of random variables, Mean (Expectation) and variance of a discrete random variables, Discrete uniform distribution, Bernoulli's distribution, Binomial distribution, Geometric distribution, Poisson's distribution, Mean and variance of a continuous random variable, Continuous uniform distribution: normal distribution, exponential distribution, Central Limit Theorem.

UNIT - III

Hypothesis testing: determining levels of significance, Types of hypothesis testing errors, Hypothesis testing for population mean for large and small samples; Comparing two population means for large and small independent samples; Comparing two population means for paired samples; Comparing two population proportions, Chi-Square, t-test and F-test, Analysis of variance (ANOVA).

UNIT - IV

Multivariate Analysis: Multivariate distributions: multivariate normal distribution and its properties, distributions of linear and quadratic forms, Wishart distribution (definition, properties), union-intersection and likelihood ratio principles, inference on mean vector, Hotelling's T2. MANOVA- Inference on covariance matrices.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: define basic tools of data analysis**.**
CO2: explain the concepts given in descriptive and inferential statistics**.**
CO3: apply statistical concepts to solve real-world statistical computing problems.
CO4: analyse the trends in data using descriptive statistics.
CO5: interpret and evaluate statistical models**.**
CO6: conclude the findings of statistical analysis.

TEXT AND REFERENCE BOOKS:

1. Ross Sheldon M., Introduction to Probability and Statistics for Engineers and Scientists, 4th edition, Academic Press, 2009.
2. Douglas S. Shafer and Zhang Zhiyi, Beginning Statistics, 2012. [Available freely online under Creative Commons by-nc-sa 3.0 license]
3. Brain S. Everitt, A Handbook of Statistical Analysis Using R, Second Edition, LLC 2014
4. Roger D. Peng, R Programming for Data Science, Lean Publishing, 2015.
5. Michael J. Crawley, Statistics, An introduction using R, Second edition, John Wiley, 2015
6. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning: Data Mining, Inference and Prediction, Springer, 2nd edition, 2009

DEEP LEARNING

Semester	VI				
Course code					
Category	Professional Core Courses				
Course title	Deep Learning				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. Introduce major deep learning algorithms, the problem settings, and their applications to solve real-world problems.
2. To introduce the idea of artificial neural networks and their architecture
3. To introduce techniques used for training artificial neural networks
4. To enable design of an artificial neural network for classification
5. To enable design and deployment of deep learning models for machine learning problems
6. To apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

UNIT - I

Introduction: Definition, History of Deep Learning Deep Learning

Applications: Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing

UNIT – II

Artificial Neural Networks: McCulloch-Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm. Feed forward Networks: Multilayer Perceptron, Gradient Descent, Back propagation, Empirical Risk Minimization, regularization.

Convolutional Networks: The Convolution Operation - Variants of the Basic Convolution Function - Structured Outputs - Data Types - Efficient Convolution Algorithms - Random or Unsupervised Features- LeNet, AlexNet

UNIT - III

Recurrent Neural Networks: Bidirectional RNNs - Deep Recurrent Networks Recursive Neural Networks - The Long Short-Term Memory and Other Gated RNNs

Generative Adversial Networks (GANs): Introduction, Discriminator, Generator, Activation, Common activation functions for GANs, BCE loss, Conditional GANs, Controllable generation, real life GANs

UNIT - IV

Deep Generative Models: Boltzmann Machines - Restricted Boltzmann Machines - Introduction to MCMC and Gibbs , Deep Belief Networks- Deep Boltzmann Machines

Optimization for Train Deep Models: Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second-Order Methods, Optimization Strategies and Meta-Algorithms

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Understand the fundamentals of deep learning and the main research activities in this field.
CO2: Emphasizing knowledge on various deep learning algorithms.
CO3: Understanding of CNN and RNN to model for real-world applications.
CO4: Understanding the various challenges involved in designing deep learning algorithms for varied applications.
CO5: Implement deep learning algorithms and solve real-world problems.
CO6: Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.

TEXT AND REFERENCE BOOKS:

1. Nikhil Buduma, “Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithm”, O’Reilly, 2017.
2. Ian Goodfellow, YoshuaBengio and Aaron Courville, “Deep Learning”, MIT Press, 2016.
3. AurélienGéron, “Hands-On Machine Learning with Scikit- Learn and TensorFlow”, O’Reilly, 2017.
4. Nikhil Ketkar, “Deep Learning with Python: A Hands-on Introduction”, Apress, 2017.
5. Tariq Rashid, "Make your own neural network ", 2017.

DEEP LEARNING LAB

Semester	VI				
Course code					
Category	Laboratory course				
Course title	Deep Learning Lab				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Classwork	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	02 Hours				

Note:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 5 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

COURSE OBJECTIVE

1. To Build the Foundation of Deep Learning.
2. To Understand How to Build the Neural Network.
3. To enable students to develop successful machine learning concepts.

CONTENTS

1. Setting up the Spyder IDE Environment and Executing a Python Program
2. Plotting of Activation Functions: Threshold functions, Signum function, Sigmoid function, Tan-hyperbolic function, Ramp function, Identity function.
3. Implementation of linearly separable concept for a problem.
4. Implementation of some basic model like MCP with suitable example
5. Installing Keras, TensorFlow and Pytorch libraries and making use of them
6. Applying the Convolution Neural Network on computer vision problems
7. Image classification on MNIST dataset (CNN model with Fully connected layer)
8. Applying the Deep Learning Models in the field of Natural Language Processing.
9. Train a sentiment analysis model on IMDB dataset, use RNN layers with LSTM/GRU notes.
10. Applying the Autoencoder algorithms for encoding the real-world data
11. Applying Generative Adversial Networks for image generation and unsupervised tasks.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: For a given conceptual problem student will be able to analyze the problem and able to visualize using NN.

CO2: Apply Artificial Neural Networks models to handle uncertainty and solve engineering problems.

CO3: Learn the Fundamental Principles of Deep Learning.

CO4: Identify the Deep Learning Algorithms for Various Types of Learning Tasks in various domains.

CO5: Implement Deep Learning Algorithms and solve Real-world problems.

STATISTICAL COMPUTING LAB

Semester	VI				
Course code					
Category	Laboratory course				
Course title	Statistical Computing Lab				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Classwork	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	02 Hours				

Note:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 5 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

CONTENTS

1. Install R and R studio.
2. Two assignments related to descriptive statistics.
3. Two assignments related to visualizing trends in data.
4. Two assignments related to permutations, combinations and probability.
5. Two assignments on Hypothesis Testing.
6. Two assignments on linear regression.
7. Two assignments on logistic regression.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: implement statistical tools for drawing inference from data.

CO2: explore the trends in datasets using descriptive statistics.

CO3: apply probability, hypothesis testing and regression for solving research questions.

CO4: Judge different problem situations for applying appropriate statistical tests.

CO5: create lab records of assignment by incorporating problem definitions, design of solutions, results and interpretations.

CO6: create lab records of assignment by incorporating problem definitions, design of solutions, results and interpretations.

PROJECT - I

Semester	VI				
Course code					
Category	Project				
Course title	Project - I				
Scheme and Credits	L	T	P	Credits	
	0	0	4	2	
Classwork	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	02 Hours				

COURSE OBJECTIVE

1. To allow students to demonstrate skills learned during their course of study by asking them to deliver a product that has passed through the design, analysis, testing and evaluation
2. To encourage research through the integration learned in a number of courses.
3. To allow students to develop problem solving skills.
4. To encourage teamwork.
5. To improve students' communication skills by asking them to produce both a professional report and to give an oral presentation and prepare a technical report.

Students will be assigned projects (Applications/Research based) individually or in a group of not more than 3 students depending on the efforts required for completion of the project.

The project will have 4 stages: (*Marks for internal evaluation are given in brackets)

1. Synopsis submission (5 marks),
2. 1st mid-term progress evaluation (Literature Survey in case of research project) (5 marks)
3. 2nd mid-term progress evaluation (Paper Publishing/acceptance in a reputed Journal or Conference acceptance/ Presenting) (5 marks)
4. Final submission evaluation

The external examiner will evaluate the project on the basis of idea/quality of project, implementation of the project, project report and/or publication and viva.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Demonstrate a sound technical knowledge of their selected project topic.
CO2: Undertake problem identification and formulation.
CO3: Design engineering formula to complex problems utilising a systems approach.
CO4: Research and engineering project.
CO5: Communicate with engineers and the community at large in written and oral form.
CO6: Demonstrate the knowledge, skills and attitudes of a professional engineer.

Professional Elective Course - II

FUZZY SYSTEMS AND APPLICATIONS

Semester	VI				
Course code					
Category	Professional Elective Courses				
Course title	Fuzzy Systems and Applications				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

UNIT - I

Fuzzy logic: Definition, Difference between Boolean and Fuzzy logic, fuzzy subset, fuzzy membership function, Classical sets vs Fuzzy Sets - Need for fuzzy sets, Mathematical representations - Level Sets - Fuzzy functions - Zadeh's Extension Principle.

UNIT - II

Operations on [0,1] - Fuzzy negation, triangular norms, t- conorms, fuzzy implications, Aggregation Operations, Fuzzy Functional Equations

Fuzzy Binary and n-ary relations - composition of fuzzy relations - Fuzzy Equivalence Relations - Fuzzy Compatibility Relations - Fuzzy Relational Equations,

UNIT - III

Fuzzy Measures - Evidence Theory - Necessity and Belief Measures - Probability Measures vs Possibility Measures, Fuzzy Decision Making - Fuzzy Relational Inference - Compositional Rule of Inference - Efficiency of Inference - Hierarchical

UNIT - IV

Fuzzy If-Then Rule Base - Inference Engine - Takagi-Sugeno Fuzzy Systems - Function Approximation Applications Advanced topics: Adaptive fuzzy inference systems: Adaptive networks - Architectures - Learning rules. Adaptive neuro-fuzzy inference systems (ANFIS) - Architectures - Hybrid learning rules**.**

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

1. Interpret fuzzy set theory and uncertainty concepts.
2. Identify the similarities and differences between probability theory and fuzzy set theory and their application conditions.
3. Apply fuzzy set theory in modeling and analyzing uncertainty in a decision problem.
4. Apply fuzzy control by examining simple control problem example.

Text Books:

1. George J Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic : Theory and Applications", Prentice Hall NJ,1995.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", 3rd Edition, Willey, 2010.

References:

1. E P Klement, R Mesiar and E. Pap, Triangular norms, Kluwer Academic Press, Dordrecht, 2000.
2. H.J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers, New Delhi, 1991.
3. Kevin M Passino and Stephen Yurkovich, Fuzzy Control, Addison Wesley Longman, 1998.
4. M Grabisch et al., Aggregation Functions, Series - Encyclopedia Of Mathematics And Its Applications, Cambridge University Press, 2009
5. Michal Baczynski and Balasubramaniam Jayaram, Fuzzy Implications, Springer Verlag, Heidelberg, 2008.

COMPUTER GRAPHICS

Semester	VI				
Course code					
Category	Professional Elective Courses				
Course title	Computer Graphics				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. To have basic understanding of the core concepts of Computer Graphics.
2. Understand scan conversion, 2D, 3D – transformation and viewing.
3. To be able to create interactive computer Graphics with understanding of shading, image processing and illumination model.

UNIT - I

Introduction to Computer Graphics: What is Computer Graphics, Computer Graphics Applications, Computer Graphics Hardware and software; Two dimensional Graphics Primitives: Points and Lines, Scan Conversion: Point, Line, Circle; Region Filling: Scanline algorithm, Polygon filling algorithm, boundary filled algorithm.

UNIT - II

Two dimensional transformations: Geometric, Coordinate and, composite transformation.

Two Dimensional Viewing: window to view port mapping; Clipping: point, line, polygon, curve and text clipping

UNIT - III

Three-dimensional transformations: Three dimensional graphics concept, Geometric and Coordinate transformations, Viewing in 3D: Projection, Taxonomy of projection,

Hidden surface removal: Introduction to hidden surface removal, The Z- buffer algorithm, The painter's algorithm, Scanline algorithm, Sub-division algorithm.

UNIT - IV

Representing Curves and Surfaces: Parametric representation of curves: Bezier curves, BSpline curves. Parametric representation of surfaces; Interpolation method.

Illumination, shading, image manipulation: Illumination models, shading models for polygons, shadows, transparency, image processing.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: ***Understand and apply*** basics about computer graphics along with graphics standards.

CO2: Understanding of the software, hardware and applications of Computer Graphics.

CO3: Understanding of Scan conversion, 2D, 3D – transformation and viewing.

CO4: ***Understand*** various colour models in computer graphics system and develop animated motions through OpenGL.

CO5: To be able to implement picture on screen using projection, shading, image processing and illumination model.

TEXT AND REFERENCE BOOKS:

1. Computer Graphics Principles and Practices second edition by James D. Foley, Andeies van Dam, Stevan K. Feiner and Johb F. Hughes, 2000, Addision Wesley.
2. Computer Graphics by Donald Hearn and M.Pauline Baker, 2 Edition, 1999, PHI
3. Computer Graphics by Z. Xiang, R. Plastock, 2nd Edition, TMH Education.
4. Procedural Elements for Computer Graphics – David F. Rogers, T.M.H latest Edition
5. Fundamentals of 3-Dimensional Computer Graphics by Alan Watt, Addision Wesley.
6. Computer Graphics: Secrets and Solutions by Corrign John, BPB
7. Graphics, GUI, Games & Multimedia Projects in C by Pilania&Mahendra, Standard Publ.
8. Computer Graphics Secrets and solutions by Corrign John, BPV
9. Introduction to Computer Graphics by N. Krishanmurthy T.M.H latest edition

INFORMATION RETRIEVAL

Semester	VI				
Course code					
Category	Professional Elective Courses				
Course Title	Information Retrieval				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. To build an understanding of the fundamental concepts of Information Retrieval
2. To understand the elements of Web Search Engines and Crawlers
3. To familiarize students with the basic taxonomy and terminology of Indices and to understand Heap's Law for estimation and Zipf's law for modeling distribution of terms
4. To understand dictionary compression and posting list compression and to introduce the scoring , tf-idf weighting and vector space model for scoring

UNIT - I

Information retrieval problem, an inverted index, Processing Boolean queries, The extended Boolean model versus ranked retrieval, an inverted index, Bi-word indexes, Positional indexes, Combination schemes

UNIT - II

Search Engines: Basic Building Blocks and Architecture, Text Acquisition, Text Transformation, Index Creation, User Interaction, Ranking, Evaluation. **CRAWL AND FEEDS:** Crawling the Web, Retrieving Web Pages, The Web Crawler, Freshness, Focused Crawling, Deep Web, Crawling Documents and Email, Storing the Documents, Detecting Duplicates

UNIT - III

INDEX CONSTRUCTION AND COMPRESSION: Hardware basics, Blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, Dynamic indexing **Index compression:** Statistical properties of terms in information retrieval, Heaps' law: Estimating the number of terms, Zipf's law: Modeling the distribution of terms, Dictionary compression, Dictionary as a string, Blocked storage, Postings file compression

UNIT - IV

SCORING, TERM WEIGHTING AND THE VECTOR SPACE MODEL: Parametric and zone indexes, Weighted zone scoring, Learning weights, The optimal weight, Term frequency and

weighting, Inverse document frequency, Tf-idf weighting, The vector space model for scoring , Computing scores in a complete search system.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Understand basic Information Retrieval Systems and learn how Boolean queries are processed.

CO2: Realize the data structures like Inverted Indices used in Information retrieval systems.

CO3: understand the basic concept of Search Engines their architecture and its various functional components and understand the basic concept of Web crawlers and their architecture

CO4: identify the different types of indices: inverted index, positional index, biword index and be able make estimations and model distribution of terms and compressions

CO5: enumerate various types of indices and also understand the concept of efficient storage of indices and learn tf-idf scoring and vector space model scoring for ranking.

TEXT AND REFERENCE BOOKS:

1. C.D.Manning, P. Raghavan and H.Schutze “Introduction to Information Retrieval”, Cambridge University Press, Latest Edition
2. B.Croft, D.Metzler, T.Strohman, “Search Engines : Information Retrieval in Practice”, AddisionWesley, Latest Edition

SOFT COMPUTING

Semester	VI				
Course code					
Category	Professional Elective Courses				
Course title	Soft Computing				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.
2. To implement soft computing based solutions for real-world problems.
3. To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms.
4. To provide students an hand-on experience on MATLAB to implement various strategies.

UNIT - I

INTRODUCTION TO SOFT COMPUTING: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics

UNIT - II

FUZZY LOGIC: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

UNIT - III

NEURAL NETWORKS: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks: Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks

UNIT - IV

GENETIC ALGORITHMS: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning : Machine Learning Approach to Knowledge Acquisition.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Identify and describe soft computing techniques and their roles in building intelligent Machines.
CO2: Develop intelligent systems leveraging the paradigm of soft computing techniques.
CO3: Implement, evaluate and compare solutions by various soft computing approaches for finding the optimal solutions.
CO4: Recognize the feasibility of applying a soft computing methodology for a particular problem.
CO5: Design the methodology to solve optimization problems using fuzzy logic, genetic algorithms.
CO6: Evaluate and compare solutions by various soft computing approaches for a given problem.

TEXT AND REFERENCE BOOKS:

1. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Applications", PHI
2. Satish Kumar, "Neural Networks: A classroom approach" Tata McGraw Hill.
3. Haykin S., "Neural Networks-A Comprehensive Foundations", PHI
4. Anderson J.A., "An Introduction to Neural Networks", PHI
5. M.Ganesh, "Introduction to Fuzzy sets and Fuzzy Logic" PHI.
6. N P Padhy and S P Simon, " Soft Computing with MATLAB Programming", Oxford University Press

COMPILER DESIGN

Semester	VI				
Course code					
Category	Professional Elective Courses				
CourseTitle	Compiler Design				
Schemeand Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30Marks				
Exam	70Marks				
Total	100Marks				
DurationofExam	03Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSEOBJECTIVE:

1. To understand and list the different stages in the process of compilation.
2. Identify different methods of lexical analysis.
3. Design top-down and bottom-up parsers.
4. Identify synthesized and inherited attributes.
5. Develop syntax-directed translation schemes.

UNIT-I

Introduction to Compilers: Language Processors, The Structure of compiler: its different phases, Compiler Construction Tools, Applications of Compiler Technology.

Lexical Analysis: Role of lexical analyzer, Input Buffering, Specification, and recognition of tokens, design of lexical analyzer, regular expressions, A language specifying lexical analyzer, Finite automata, conversion from regular expression to finite automata, and vice versa, minimizing the number of states of DFA, Implementation of lexical analyzer.

UNIT-II

Syntax Analysis: Role of parsers, context-free grammars.

Parsing Technique: Shift-reduce parsing, Operator precedence parsing, Top-down parsing, Predictive parsing.

UNIT-III

LR parsers, SLR, LALR, and Canonical LR parser.

Syntax Directed Translations: Syntax-directed definitions, construction of syntax trees, syntax-directed translation scheme, implementation of syntax-directed translation, Intermediate-Code Generation: three address code, quadruples and triples.

UNIT-IV

Symbol Table & Error Detection, and Recovery: Symbol tables: its contents and data structure for symbol tables; trees, arrays, linked lists, hash tables. Errors, lexical phase error, syntactic phase error, and Semantic error.

Code Optimization & Code Generation: Code generation, forms of objects code, machine-dependent code, optimization, register allocation for temporary and user defined variables.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: state principles of compiler design.

CO2: illustrate the essential phases for automatically converting source code into object code.

CO3: apply lexical analysis, syntax analysis and code optimization techniques for solving problems.

CO4: analyse a parse tree and a given BNF grammar.

CO5: compare and contrast syntax-oriented translation schemes.

CO6: design a lexical analyser from the specification of a language's lexical rules.

TEXT AND REFERENCE BOOKS:

1. Theory and practice of compiler writing, Tremblay & Sorenson,1985,MGH.
2. System software by Dhamdhere, 1986, MGH.
3. Principles of compiler Design ,Narosa Publication
4. Elements compiler Design, M. Joseph,University Science Press
5. Compilers Principle, Techniques & Tools – Alfred V. AHO, Ravi Sethi & J.D. Ullman; 1998 Addison Wesley.

Professional Elective Course - III

NETWORK SECURITY AND CRYPTOGRAPHY

Semester	VI				
Course code					
Category	Professional Elective Courses				
Course title	Network Security And Cryptography				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. To understand cryptography theories; algorithms & systems.
2. To understand the symmetric and asymmetric key algorithms.
3. To understand necessary approaches & techniques to build protection mechanisms in order to secure Computer Networks.
4. Acquire fundamental knowledge on the concepts of different security layers.

UNIT - I

Introduction: Plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography.

UNIT - II

Symmetric Key Algorithms: Introduction, algorithms types and modes, DES, AES.

Asymmetric Key Algorithms: Introduction, history of asymmetric key cryptography, RSA symmetric and asymmetric key cryptography together, Digital signature.

UNIT - III

Internet Security Protocols: Basic concepts, Secure Socket Layer (SSL), Transport Layer Security (TLS), Secure Hyper Text Transfer protocol (SHTTP), Time Stamping Protocol (TSP), Secure Electronic Transaction (SET), S SL versus SET, Electronic Money, Email Security.

UNIT - IV

User Authentication And Kerberos: - Introduction, Authentication basics, Passwords, authentication tokens, certificate-based authentication, biometric-based authentication, Kerberos, key distribution center(KDC), Security handshake pitfalls, single Sign on(SSO) approach.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Identify services that enhance the security and its mechanism.

CO2: Classify security attacks on information over network. Describe and apply classical encryption techniques.

CO3: Explain and apply modern block cipher with modes

CO4: Compare conventional encryption algorithms & public key cryptography, and design Encryption algorithm to provide the Integration and confidentiality of a message.

CO5: Understand the concept of hash function with application and message authentication code in security system

CO6: Classify key management schemes and discuss web security and transport level security protocols.

TEXT AND REFERENCE BOOKS:

1. Cryptography and Network Security, 2nd Edition by Atul Kahate, TMH
2. Network Management Principles & Practices by Subramanian, Mani (AWL)
3. SNMP, Stalling, Willian (AWL)
4. SNMP: A Guide to Network Management (MGH)
5. Telecom Network Management by H.H. Wang (MGH)
6. Network Management by U. Dlack (MGH)

INTERNET TECHNOLOGIES

Semester	VI				
Course code					
Category	Professional Elective Courses				
Course title	Internet Technologies				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

UNIT - I

WEB SERVERS: Web Protocols- Working of web browser - Browser & Server Communication - Web Server Functions - Web Security - Fire Wall - Proxy Servers - Virtual Directories - MIME - HTTP Headers - Deployment using web servers.

WEB PROGRAMMING: HTML5 Structural Elements-Images - HTML5 Form Elements and Attributes - DHTML - CSS3-Selectors-Box model-Positioning elements-Colors-Shadows-Gradients-Transitions and Transformations.

UNIT - II

JAVASCRIPT: Java Script - Core JavaScript - lexical structure- types-values and variables-expression and operators-statements-objects arrays-functions- classes and modules- pattern matching with regular expressions- java script in web browser-the window objects scripting documents-handling events.

UNIT - III

ANGULARJS: An Overview of the AngularJS Life Cycle-Integrating AngularJS with Existing JavaScript and jQuery-Adding AngularJS to the Node.js Environment-Bootstrapping AngularJS in an HTML Document- Creating a Basic AngularJS Application-Using AngularJS Templates to Create Views- Implementing Directives in AngularJS Views- Implementing AngularJS Services in Web Applications.

NODE.JS: Using Events, Listeners, Timers, and Callbacks in Node.js-5 Handling Data I/O in Node.js- Accessing the File System from Node.js- Implementing HTTP Services in Node.js- implementing Socket Services in Node.js- Scaling Applications Using Multiple Processors in Node.js- Implementing Express in Node.js

UNIT - IV

MONGODB: Understanding NoSQL and MongoDB- Manipulating MongoDB Documents from Node.js- Accessing MongoDB Documents from Node.js- Advanced MongoDB Concepts

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Understanding of the concept of the web servers and its working.
CO2: Analyze a web page and identify its elements and attributes.
CO3: Build dynamic web pages using JavaScript (Client side programming).
CO4: Acquire in depth knowledge in web services using the latest server-side technologies.
CO5: Ability to design and develop web server applications using Node JS and Angular JS.
CO6: Demonstrate the connectivity of web pages and database like NoSQL and MongoDB.

TEXT AND REFERENCE BOOKS:

1. Deitel & Deitel, "Internet & World Wide Web How to Program", Pearson Education India, fifth Edition, 2011.
2. David Flanagan "JavaScript: The Definitive Guide, O'Reilly Media, Inc. May 2011.
3. Brad Dayley "Node.js, MongoDB, and AngularJS Web Development", Addison-Wesley Professional. 2014
4. Brad Green, Shyam Seshadri "AngularJS", O'Reilly; 1st Edition Apr 2013.
5. Negrino and Smith, "Javascript for the World Wide Web", 5th Edition, Peach pit Press,2003

MOBILE APPLICATIONS DEVELOPMENT

Semester	VI				
Course code					
Category	Professional Elective Courses				
Course title	Mobile applications development				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. Introduce the students with the various "Next Generation Technologies" in the area of mobile computing
2. Assist students understand the various Mobile operating Systems
3. Explore the findings using Android Technologies

UNIT - I

Introduction: Mobile operating system, Operating system structure, Constraints and Restrictions, Hardware configuration with mobile operating system, Features: Multitasking Scheduling, Memory Allocation, File System Interface, Keypad Interface, I/O Interface, Protection and Security, Multimedia features

UNIT - II

Introduction to Mobile development IDE's, Introduction to Worklight basics, Optimization, pages and fragments , Writing a basic program- in Worklight Studio, Client technologies, Client side debugging, Creating adapters, Invoking adapters from Worklight Client application, Common Controls, Using Java in adapters, Programming exercise with Skins, Understanding Apache Cordova.

UNIT - III

Understanding Apple iOS development, Android development, Shell Development, Creating Java ME application, Exploring the Worklight Server, Working with UI frameworks, Authentication, Push notification, SMS Notifications, Globalization.

UNIT - IV

Android: Introduction to Android, Architecture, memory management, communication protocols, application development methods, deployment. iOS: Introduction to iOS, Architecture, memory management, communication protocols, application development methods, deployment

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Explain the principles and theories of mobile computing technologies.
CO2: Describe infrastructures and technologies of mobile computing technologies.
CO3: List applications in different domains that mobile computing offers to the public, employees, and businesses.
CO4: Describe the possible future of mobile computing technologies and applications.
CO5: Effectively communicate course work through written and oral presentations

TEXT AND REFERENCE BOOKS:

1. Anubhav Pradhan, Anil V Deshpande, " Mobile Apps Development" Edition:
2. Jeff McWherter, Scott Gowell "Professional Mobile Application Development", John Wiley & Sons, 2012.
3. Barry Burd, "Android Application Development All in one for Dummies", Edition: I
4. Teach Yourself Android Application Development In 24 Hours, Edition: I, Publication: SAMS
5. Neal Goldstein, Tony Bove, "iPhone Application Development All-In-One For Dummies", John Wiley & Sons
6. Henry Lee, Eugene Chuvyrov, "Beginning Windows Phone App Development", Apress, latest edition.
7. Jochen Schiller,"Mobile Communications", Addison-Wesley, latest edition
8. Stojmenovic and Cacute, "Handbook of Wireless Networks and Mobile Computing", Wiley, 2002, ISBN 0471419028.

ADVANCE DATABASE MANAGEMENT SYSTEM

Semester	VI				
Course code					
Category	Professional Elective Courses				
Course title	Advance Database Management System				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. To understand DBMS Components, Advantages and Disadvantages.
2. Understanding Data modeling: ER, EER, Network, Hierarchical and Relational data models.
3. Understanding normalization, general strategies for query processing, query processor, syntax analyzer, Query decomposition, Heuristic Query optimization.
4. To understand transaction concept, schedules, serializability, locking and concurrency control protocols.

UNIT - I

Introduction: Architecture, Advantages, Disadvantages, Data models, relational algebra, SQL, Normal forms.

Query Processing: General strategies for query processing, transformations, expected size, statistics in estimation, query improvement. Query evaluation, view processing, query processor.

UNIT - II

Recovery: Reliability, Transactions, recovery in centralized DBMS, reflecting updates, Buffer management logging schemes, disaster recovery.

Concurrency: Introduction, Serializability, Concurrency control, locking schemes, Timestamp based ordering, Optimistic, Scheduling, Multi-version techniques, Deadlocks.

UNIT - III

Parallel and Distributed Databases: Distributed Data Storage – Fragmentation & Replication, Location and Fragment.

Transparency Distributed Query Processing and Optimization, Distributed Transaction Modeling and concurrency Control, Distributed Deadlock, Commit Protocols, Design of Parallel Databases, Parallel Query Evaluation.

UNIT - IV

Objected Oriented and Object Relational Databases: Modeling Complex Data Semantics, Specialization, Generalization, Aggregation and Association, Objects, Object Identity, Equality and Object Reference, Architecture of Object Oriented and Object Relational Databases

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Students will get understanding of DBMS Components, Its advantages and disadvantages.

CO2: Understanding about various types of Data modeling: ER, EER, Network, Hierarchical and Relational data models.

CO3: Explain the concept of distributed database architecture & design and web technology using databases.

CO4: Understanding normalization, general strategies for query processing, query processor, syntax analyzer, Query decomposition, Heuristic Query optimization.

CO5: Understanding transaction concept, schedules, serializability, locking and concurrency control protocols.

TEXT AND REFERENCE BOOKS:

1. Elmarsi, Navathe, Somayajulu, Gupta, "Fundamentals of Database Systems", 4th Edition, Pearson Education,2007
2. Garcia, Ullman, Widom, "Database Systems, The complete book", Pearson Education, 2007
3. R. Ramakrishnan, "Database Management Systems", McGraw Hill International Editions, 1998
4. Date, Kannan, Swaminathan, "An Introduction to Database Systems", 8th Edition Pearson Education, 2007 2
5. Singh S.K., "Database System Concepts, design and application", Pearson Education, 2006.
6. Silberscatz, Korth, Sudarshan, "Database System Concepts", Mcgraw Hill, 6th Edition, 2006
7. W. Kim, "Modern Database Systems", 1995, ACM Press, Addision Wesley

CLOUD COMPUTING

Semester	VI				
Course code					
Category	Professional Elective Courses				
Course title	Cloud Computing				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. To provide students with the fundamentals and essentials of Cloud Computing.
2. To provide students a sound foundation of the Cloud Computing so that they are able to start using and adopting Cloud Computing services and tools in their real life scenarios.
3. To enable students exploring some important cloud computing driven commercial systems and applications.
4. To expose the students to frontier areas of Cloud Computing and information systems, while providing sufficient foundations to enable further study and research.

UNIT - I

INTRODUCTION TO CLOUD COMPUTING: Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing.

UNIT - II

CLOUD COMPUTING ARCHITECTURE: Requirements, Introduction Cloud computing architecture, On Demand Computing Virtualization at the infrastructure level, Security in Cloud computing environments, CPU Virtualization, A discussion on Hypervisors Storage Virtualization Cloud Computing Defined, The SPI Framework for Cloud Computing, The Traditional Software Model, The Cloud Services Delivery Model Cloud Deployment Models Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise .

UNIT - III

SECURITY ISSUES IN CLOUD COMPUTING: Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security Identity and Access Management Trust Boundaries and IAM, IAM Challenges, Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management

SECURITY MANAGEMENT IN THE CLOUD: Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IaaS Privacy Issues Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications, U.S. Laws and Regulations, International Laws and Regulations

UNIT - IV

AUDIT AND COMPLIANCE: Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Regulatory/External Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance, Security-as-a Cloud.

DATA INTENSIVE COMPUTING: Map-Reduce Programming Characterizing Data-Intensive Computations, Technologies for Data- Intensive Computing, Storage Systems, Programming Platforms, MapReduce Programming, MapReduce Programming Model, Example Application

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Recall and summarize the basic concepts of cloud computing
CO2: Discuss the architectural design of cloud and illustrate various programming models.
CO3: Outline the virtualization technology and determine their uses.
CO4: Explain the basic threats and security mechanism in cloud
CO5: Summarize the cloud available platforms for business and industry perspective

TEXT AND REFERENCE BOOKS:

1. "Cloud Computing Explained: Implementation Handbook for Enterprises", John Rhoton, Publication Date: November 2, 2009
2. "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice)", Tim Mather, ISBN-10: 0596802765,O'Reilly Media, September 2009

7TH SEMESTER

B. Tech. (Computer Science and Engineering- Artificial Intelligence & Data Science)
Scheme of Studies/Examination w.e.f. 2023-24

Semester- VII

S.N.	Category	Course Code	Course Title	Hours Per week			Total Contact Hrs. per week	Credits	Examination Schedule (Marks)			
				L	T	P			Marks of Class work	Marks of Class work	Practical	Total
1.	**PCC**		Intelligent and Expert System	3	0	0	3	3	30	70		100
2.	**PEC**		Professional Elective Course -IV	3	0	0	3	3	30	70		100
3.	**PEC**		Open Elective Course -III	3	0	0	3	3	30	70		100
4.	**OEC**		Open Elective Course -IV	3	0	0	3	3	30	70		100
5.	**HSMC**		Organizational Behaviour	3	0	0	3	3	30	70		100
6.	**LC**		Intelligent and Expert System Lab	0	0	2	2	1	50		50	100
7.	**PROJECT**		Project-II	0	0	8	8	4	100		100	200
8.	**PT**		Practical Training-II	0	0	2	2	1	50		50	100
			Total	**15**	**0**	**12**	**27**	**21**	**350**	**350**	**200**	**900**

NOTE:

1. **The evaluation of Practical Training–II will be based on the seminar,viva-voice, and report submitted by the students.**
2. **Choose anyone from Professional Elective Course – IV**
3. **Choose anyone from Open Elective Course –III & IV**

Professional Elective Course–IV

1. Cyber Security Threats
2. Network Security Applications using AI
3. Web Mining
4. Natural Language Processing
5. Image Analytics
6. Information Hiding Techniques

INTELLIGENT AND EXPERT SYSTEM

Semester	VII				
Course code					
Category	Professional Core Courses				
Course title	Intelligent and Expert System				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. Understanding AI programming as base of Intelligent System.
2. Understand the Expert system architecture and its development cycle.
3. Understand problem with Expert system.
4. Gaining knowledge of tools and their implementation.
5. Building expert system for a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

UNIT - I

Introduction to Intelligent System: AI programming, Blind search strategies, Breadth-first – Depth-first – Heuristic search techniques Hill Climbing – Best first – A Algorithms AO* algorithm – game tress, Minmax algorithms, game playing – Alpha-beta pruning.

Introduction to Expert Systems: Architecture of expert systems, Representation and organization of knowledge, Basics characteristics, and types of problems handled by expert systems.

UNIT - II

Expert system development life cycle: Problem selection, Prototype construction, Formalization, Implementation, Evaluation, Knowledge acquisition: Knowledge engineer, Cognitive behavior, Acquisition techniques.

Problems with Expert Systems: Difficulties, common pitfalls in planning, dealing with domain experts, difficulties during development

UNIT – III

Expert System Tools: Techniques of knowledge representations in expert systems, knowledge engineering, system-building aids, support facilities, stages in the development of expert systems.

Building an Expert System: Expert system development, Selection of the tool, Acquiring Knowledge, Building process.

UNIT – IV

Expert Systems and their Applications: Justification, structure, knowledge sources; Expert knowledge acquisition; Expert system languages; ES building tools/shells; Applications of AI in CAD, CAPP, process selection, GT, MRP II, adaptive control, robotics, process control, fault diagnosis, failure analysis, etc

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Understand the fundamentals of Intelligent System and the main research activities in this field.

CO2: Emphasizing knowledge on various Artificial Intelligence algorithms.

CO3: Understanding the architecture of an expert system and its tools for real-world applications.

CO4: Understand the importance of building an expert system

CO5: Understanding the various challenges involved and problems with an expert system.

TEXT AND REFERENCE BOOKS:

1. Elain Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw-Hill, New Delhi.
2. Waterman D.A., "A Guide to Expert Systems", Addison Wesley Longman.
3. Stuart Russel and other Peter Norvig, "Artificial Intelligence – A Modern Approach", Prentice-Hall.
4. Patrick Henry Winston, "Artificial Intelligence", Addison Wesley.
5. Patterson, Artificial Intelligence & Expert System, Prentice Hall India, 1999.
6. Hayes-Roth, Lenat, and Waterman: Building Expert Systems, Addison Wesley
7. Weiss S.M. and Kulikowski C.A., "A Practical Guide to Designing Expert Systems", Rowman & Allanheld, New Jersey.

ORGANIZATIONAL BEHAVIOR

Semester	VII				
Course code					
Category	HSMC				
Course title	Organizational Behavior				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

The objective of this course is to expose the students to basic concepts of management and provide insights necessary to understand behavioral processes at individual, team and organizational level.

UNIT - II

Introduction of Management- Meaning, definitions, nature of management; Managerial levels, skills and roles in an organization; Functions of Management: Planning, Organizing, staffing, Directing & Controlling, Interrelationship of managerial functions, scope of management & Importance of management. Difference between management and administration.

UNIT - II

Introduction of organization: - Meaning and process of Organization, Management v/s Organization;

Fundamentals of Organizational Behavior: Concepts, evolution, importance and relationship with other Fields; Contemporary challenges and opportunities of OB.

Individual Processes and Behavior-Personality- Concept, determinants and applications; **Perception-** Concept, process and applications,

Learning- Concept (Brief Introduction);

Motivation- Concept, techniques and importance.

UNIT - III

Interpersonal Processes- Teams and Groups- Definition of Group, Stages of group development, Types of groups, meaning of team, merits and demerits of team; difference between team and group,

Conflict- Concept, sources, types, management of conflict;

Leadership: Concept, function, styles & qualities of leadership.

Communication – Meaning, process, channels of communication, importance and barriers of communication.

UNIT - IV

Organizational Processes: Organizational structure - Meaning and types of organizational structure and their effect on human behavior;

Organizational culture - Elements, types and factors affecting organizational culture. **Organizational change:** Concept, types & factors affecting organizational change, Resistance to Change.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Students will be able to apply the managerial concepts in practical life.

CO2: The students will be able to understand the concept of organizational behavior at individual level and interpersonal level.

CO3: Students will be able to understand the behavioral dynamics in organizations.

CO4: Students will be able to understand the organizational culture and change.

CO5: To develop creative and innovative ideas that could positively shape the organizations.

CO6: To accept and embrace in working with different people from different cultural and diverse background in the workplace.

TEXT AND REFERENCE BOOKS:

1. Robbins, S.P. and Decenzo, D.A. Fundamentals of Management, Pearson Education Asia, New Delhi.
2. Stoner, J et. al, Management, New Delhi, PHI, New Delhi.
3. Satya Raju, Management – Text & Cases, PHI, New Delhi.
4. Kavita Singh, OrganisationalBehaviour: Text and cases. New Delhi: Pearson Education.
5. Pareek, Udai, Understanding OrganisationalBehaviour, Oxford University Press, New Delhi.
6. Robbins, S.P. & Judge, T.A., OrganisationalBehaviour, Prentice Hall of India, New Delhi.
7. GhumanKarminder, Aswathappa K., Management concept practice and cases, Mc Graw Hill education.
8. Chhabra T. N., Fundamental of Management, Sun India Publications-New Delhi

INTELLIGENT AND EXPERT SYSTEM LAB

Semester	VII				
Course code					
Category	Laboratory course				
Course title	Intelligent and Expert System Lab				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Classwork	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	02 Hours				

Note:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 5 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

CONTENTS

Implementation / development of programs using Python or any suitable Programming Language.

1. Developing agent programs for real world problems
2. Implementation and Analysis of DFS and BFS for an application
3. Developing Best first search and A* Algorithm for real world problems
4. Implementation of minimax algorithm for an application
5. Implementation of uncertain methods for an application
6. Implementation of block world problem
7. Implementation of learning algorithms for an application
8. Development of ensemble model for an application
9. Expert System case study
10. Implementation of NLP programs
11. Applying deep learning methods to solve an application.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Apply AI techniques and technologies to solve real world business problems

CO2: Understand the fundamentals of theorem proving using AI tools

CO3: Demonstrate working knowledge of reasoning in the presence of incomplete and/or uncertain information

CO4: Identify and apply the suitable Expert models for the given real-world problem.

CO5: Undertake problem identification, formulation and solution in Expert System

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PRACTICAL TRAINING – II

Semester	VII				
Course code					
Category	Practical Training (PT)				
Course title	Practical Training - II				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Classwork	50				
Exam	50				
Total	100				
Duration of Exam	02 Hours				

The evaluation of Practical Training - I will be based on the seminar, viva voice, and report submitted by the students.

PROJECT - II

Semester	VII				
Course code					
Category	Project				
Course title	Project - II				
Scheme and Credits	L	T	P	Credits	
	0	0	8	4	
Classwork	100 Marks				
Exam	100 Marks				
Total	200 Marks				
Duration of Exam	03 Hours				

COURSE OBJECTIVE

1. To allow students to demonstrate a wide range of the skills by working on PROJECT-I that has passed through the design, analysis, testing and evaluation.
2. To encourage problem solving skills.
3. To allow students to develop problem solving, synthesis and evaluation skills.
4. To encourage teamwork and leadership.
5. To improve students' communication skills by asking them to produce both a professional report and a professional poster and to give an oral presentation.

Students will be assigned projects individually or in a group of not more than 3 students depending on the efforts required for completion of project.

The project will have 4 stages:

(*Marks for internal evaluation are given in brackets)

1. Synopsis submission (10 marks)
2. 1st mid-term progress evaluation (10 marks)
3. 2nd mid-term progress evaluation (10 marks)
4. Final submission evaluation (20 marks)

The external examiner will evaluate the project on the basis of idea/quality of project, implementation of the project, project report and/or publication and viva.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Demonstrate a sound technical knowledge of their selected project solution.
CO2: Undertake problem solution.
CO3: Design engineering solutions to complex problems utilising a systems approach.
CO4: Conduct the remaining engineering project.
CO5: Communicate with team members at large in written an oral form.
CO6: Demonstrate the knowledge, skills and attitudes of a professional engineer.

Professional Elective Course - IV

CYBER SECURITY THREATS

Semester	VII				
Course code					
Category	Professional Elective Courses				
Course title	Cyber Security Threats				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. The learner will gain knowledge about securing both clean and corrupted systems, protect personal data, and secure computer networks.
2. The learner will understand key terms and concepts in cyber law, intellectual property and cybercrimes, trademarks and domain theft.
3. The learner will be able to examine secure software development practices.
4. The learner will understand principles of web security.
5. The learner will be able to incorporate approaches for risk management and best practices.
6. The learner will gain an understanding of cryptography, how it has evolved, and some key encryption techniques used today.

UNIT - II

Introduction: Security threats - Sources of security threats- Motives - Target Assets and vulnerabilities – Consequences of threats- E-mail threats - Web-threats - Intruders and Hackers, Insider threats, Cyber crimes. Network Threats: Active/ Passive – Interference – Interception – Impersonation – Worms –Virus – Spam's – Ad ware - Spy ware – Trojans and covert channels – Backdoors – Bots – IP, Spoofing - ARP spoofing - Session Hijacking - Sabotage-Internal treats Environmental threats - Threats to Server security.

UNIT - II

Security Threat Management: Risk Assessment - Forensic Analysis - Security threat correlation –Threat awareness - Vulnerability sources and assessment- Vulnerability assessment tools –Threat identification - Threat Analysis - Threat Modelling - Model for Information Security Planning.

UNIT - III

Security Elements: Authorization and Authentication - types, policies and techniques – Security certification - Security monitoring and Auditing - Security Requirements Specifications – Security Policies and Procedures, Firewalls, IDS, Log Files, Honey Pots

UNIT - IV

Access control, Trusted Computing and multilevel security - Security models, Trusted Systems, Software security issues, Physical and infrastructure security, Human factors – Security awareness, training, Email and Internet use policies.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Analyze and resolve security issues in networks and computer systems to secure an IT infrastructure.

CO2: Design, develop, test and evaluate secure software.

CO3: Develop policies and procedures to manage enterprise security risks.

CO4: Evaluate and communicate the human role in security systems with an emphasis on ethics, social engineering vulnerabilities and training.

CO5: Interpret and forensically investigate security incidents.

TEXT AND REFERENCE BOOKS:

1. Swiderski, Frank and Syndex, “Threat Modeling”, Microsoft Press, 2004.
2. William Stallings and Lawrie Brown, “Computer Security: Principles and Practice”, Prentice Hall, 2008.
3. Joseph M Kizza, “Computer Network Security”, Springer Verlag, 2005
4. Thomas Calabres and Tom Calabrese, “Information Security Intelligence: Cryptographic Principles & Application”, Thomson Delmar Learning, 2004.

NETWORK SECURITY APPLICATIONS USING AI

Semester	VII				
Course code					
Category	Professional Elective Courses				
Course title	Network Security Applications using AI				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. To make students understand the foundational concepts of cybersecurity, including the CIA Triad, types of attacks, and risk management.
2. To introduce students to the role of machine learning in network security, focusing on classifiers like Logistic Regression, Decision Trees, Random Forest, and SVM.
3. To provide students with practical knowledge on applying machine learning techniques to real-world problems like credit card fraud detection and email spam filtering.
4. To help students gain hands-on experience with Intrusion Detection Systems (IDS) and understand network-based intrusions using both shallow and deep learning models.
5. To enable students to evaluate and compare machine learning models in network security, addressing issues like underfitting, overfitting, and model tuning for better performance.

UNIT-I

Introduction to Security: Basic Cyber Security Concepts, layers of security, Vulnerability,threat, Harmful acts, Computer Criminals, CIATriad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks,hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defense,Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism.

UNIT-II

Need of machine learning in Network Security, Overview of machine learning classifiers: Logistic Regression, Decision Tree, Random Forest, SVM, meaning of machine learning model, training, testing, validation and cross validation of machine learning models, computation and meaning of performance metrics of machine learning models: Accuracy, Precision, Recall, F1-Score, ROC and AUC,Confusion matrix, underfitting and overfitting.

UNIT-III

Understanding Credit Card Fraud, Recent Credit Card Fraud incidents and their financial implications, exploring datasets for credit card fraud, investigation of deep learning models for credit card fraud detection in terms of various performance metrics

E-mail spamming: Incidents of e-mail-spamming, Datasets related to e-mail spamming, Natural language processing of e-mails for spam detection.

UNIT-IV

Overview of Intrusion Detection, Network Based Intrusion, Various types of Network Intrusions, Motivation behind Network based Intrusion Detection, Datasets for Network Based Intrusion Detection, statistical characteristics of mostly used datasets, data preprocessing, comparative analysis of shallow machine learning classifiers and deep learning models for intrusion detection.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

- Understand and apply core cybersecurity concepts such as the CIA Triad, risk management, and defense strategies against various types of attacks.
- Implement machine learning techniques to address network security challenges, including intrusion detection, fraud detection, and spam filtering using classifiers like Logistic Regression, Decision Trees, Random Forest, and SVM.
- Analyze real-world datasets for credit card fraud and email spam detection, applying deep learning models and evaluating their performance using key metrics like accuracy, precision, recall, and F1-Score.
- Design and develop Intrusion Detection Systems (IDS), leveraging both shallow and deep learning models, to identify and mitigate network intrusions in real-time.
- Evaluate and fine-tune machine learning models to improve performance by addressing issues like underfitting, overfitting, and optimizing model parameters for better accuracy and reliability in network security applications.

TEXTAND REFERENCE BOOKS:

1. Machine Learning by E. Alpaydin, MIT Press, 2010
2. Dataset for machine learning at https://www.kaggle.com/datasets
3. Dataset for Network based intrusion https://www.caida.org/catalog/datasets/completed datasets/
4. Nina Godbole and SunitBelpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley
5. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018

WEB MINING

Semester	VII				
Course code					
Category	Professional Elective Courses				
Course title	Web Mining				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. To understand the architecture of web, mining the data, issues, challenges.
2. To study the methods of extracting knowledge from web data, text and unusual data.
3. To understand and use data mining language like R, Python etc.
4. To understand the optimization of web and its applications.

UNIT - II

Data Mining Foundations: Basic concepts in data Mining, Web mining versus Data mining, discovering knowledge from Hypertext data; An overview of web mining: What is Web mining, Web mining taxonomy, Web mining subtasks, issues, challenges

UNIT - II

Web Search and Information Retrieval: Information Retrieval Models, Web Search and IR, Text Mining, Latent Semantic Indexing, Web Spamming, Clustering and Classification of Web Pages, Information Extraction, Web Content Mining;

UNIT - III

Optimization: Introduction to Models and Concept of Computational Intelligence, Social Behavior as Optimization: Discrete and Continuous Optimization Problems, Classification of Optimization Algorithms, Evolutionary Computation Theory and Paradigm, Swarm and Collective intelligence

UNIT - IV

Swarm Intelligence Techniques: Particle Swarm Optimization, Ant Colony Optimization, Artificial Bees and Firefly Algorithm etc., Hybridization and Comparisons of Swarm Techniques, Application of Swarm Techniques in Different Domains and Real-World Problems

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Analyse the power of web search engine by classifying the web documents and identifying the web pages

CO2: Learn how the Web mining helps to improve the power of web search engine by classifying the web documents and identifying the web pages.
CO3: How to predict user behaviour in the web.
CO4: For a given data set how the optimization will be performed.
CO5: Understand the working logic of swarm intelligence techniques.

TEXT AND REFERENCE BOOKS:

1. Witton Frank, Data Mining, Morgan Kauffan Publishers.
2. Kennedy, J. and Eberhart, R.C., Swarm Intelligence, Morgan Kaufmann Publishers, 2001
3. Bonabeau, E., Dorigo, M. and Theraulaz, G., Swarm Intelligence: From Natural to Artifical Systems, Oxford University Press, 1999
4. Dorigo, M., Stutzle, T., Ant Colony Optimization, MIT Press, 2004
5. Parsopoulos, K.E., Vrahatis, M.N., Particle Swarm Optimization and Intelligence: Advances and Applications, Information Science Reference, IGI Global, 2010
6. Clerc, M., ParticleSwarm Optimization, ISTE, 2006
7. Nature Inspired Metaheuristic Algorithms, Xin-She Yang, Luniver Press, 2010

NATURAL LANGUAGE PROCESSING

Semester	VII				
Course code					
Category	Professional Elective Courses				
Course title	Natural Language Processing				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. Extract information from text automatically using concepts and methods from natural language processing (NLP) including stemming, n-grams, POS tagging, and parsing.
2. Analyze the syntax, semantics, and pragmatics of a statement written in a natural language.
3. Develop speech-based applications that use speech analysis (phonetics, speech recognition, and synthesis).
4. Evaluate the performance of NLP tools and systems.

UNIT - I

Introduction: A computational framework for natural language, description of English or an Indian language in the framework lexicon, algorithms and data structures for implementation of the framework, Finite state automata, the different analysis levels used for NLP (morphological, syntactic, semantic, pragmatic, Recursive and augmented transition networks. Applications like machine translations.

UNIT - II

Word level and syntactic analysis

Word Level Analysis: Regular Expressions, Finite-State Automata, Morphological Parsing, Spelling Error Detection and correction, Words and Word classes, Part-of-Speech Tagging. Syntactic Analysis: Context-free Grammar, Constituency, Parsing-Probabilistic Parsing. Machine-readable dictionaries and lexical databases, RTN, ATN.

UNIT - III

Semantic Analysis: Meaning Representation, Lexical Semantics, Ambiguity, Word Sense Disambiguation. Discourse Processing: cohesion, Reference Resolution, Discourse Coherence and Structure. Knowledge Representation, reasoning.

Natural Language Generation (NLG): Architecture of NLG Systems, Generation Tasks and Representations, Application of NLG.

Machine Translation: Problems in Machine Translation, Characteristics of Indian Languages, Machine Translation Approaches, Translation involving Indian Languages.

UNIT - IV

Information Retrieval: Design features of Information Retrieval Systems, Classical, Non-classical, Alternative Models of Information Retrieval, valuation

Lexical Resources: World Net, Frame Net, Stemmers, POS Tagger.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

- **CO1:** Understand language and the tools that are available to efficiently study and analyse large collections of text.
- **CO2:** Understand the concepts of linguistic foundations that underlie natural language processing, which would provide the knowledge for building components of NLP systems.
- **CO3:** Learn computational frameworks for natural language processing.
- **CO4:** Demonstrate the concepts of morphology, syntactic analysis, semantic interpretation and pragmatics of the language, and understanding them to apply in different research areas.
- **CO5:** Recognize the significance of research in natural language processing for common NLP tasks such as text classification, spam filtering, spell checking, machine learning, etc. to engage in lifelong learning.
- **CO6:** Understand the concepts of linguistic foundations that underlie natural language processing, which would provide the knowledge for building components of NLP systems.

TEXT AND REFERENCE BOOKS:

1. Natural Language understanding by James Allen, Pearson Education, 2002.
2. NLP: A Paninian Perspective by Akshar Bharati, Vineet Chaitanya, and Rajeev Sangal, Prentice Hall, 2016.
3. Meaning and Grammar by G. Chirchia and S. McConnell Ginet, MIT Press, 1990.
4. An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition by Daniel Jurafsky and James H. Martin, Pearson Education, 2006.
5. Natural language processing in Prolog by Gazdar, & Mellish, Addison-Wesley
6. https://www.coursera.org/specializations/natural-language-processing

IMAGE ANALYTICS

Semester	VII				
Course code					
Category	Professional Elective Courses				
Course title	Image Analytics				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

5. Learn Fundamentals of Image Processing.
6. Understand the morphology of image processing.
7. Understand Image segmentation, feature extraction and feature selection.
8. Understand and implementation of Image pattern classification.

UNIT – I

Introduction – Fundamental steps in Image Processing Systems – Image Acquisition – Sampling and Quantization – Pixel Relationships – Mathematical Tools Used in Digital Image Processing. Some Basic Intensity Transformation Functions: Image Negatives, Log Transformations, Power-Law Transformations - Histogram Processing. Color Fundamentals - Fundamentals of Spatial Filtering - Smoothing Spatial Filters - Sharpening Spatial Filters.

UNIT - II

Morphological Image Processing:

Morphological Image Processing: Fundamentals - Erosion and Dilation - Opening and Closing – Hit or Miss Transform - Some Basic Morphological Algorithms – Morphological Reconstruction – Grayscale Morphology

UNIT - III

Image Segmentation

Introduction - Point, Line, and Edge Detection – Thresholding: Foundation, Basic Global thresholding, Optimum Global Thresholding using Otsu's Method, Multiple Thresholds, Variable Thresholding – Segmentation by Region Growing and by Region Splitting and Merging – Image Segmentation: Active Contours: Snakes and Level Sets.

Feature Extraction

Background - Representation – Boundary Preprocessing – Boundary Feature Descriptors: Some Basic Boundary Descriptors, Shape Numbers, Fourier Descriptors, Statistical Moments - Regional Feature Descriptors: Some Basic Descriptors, Topological and Texture Descriptors, Moment Invariants – Principal Components as Feature Descriptors – Whole-image Features Object – Scale-Invariant Feature Transform (SIFT).

UNIT - IV

Image Pattern Classification

Background -Patterns and Pattern Classes – Pattern Classification by Prototype Matching: Minimum-Distance Classifier, Using Correlation for 2-D prototype matching, Matching SIFT Features, Matching Structural Prototypes - Optimum (Bayes) Statistical Classifiers – Neural Networks and Deep Learning: Background - The Perceptron - Multilayer Feedforward Neural Networks - Deep Convolutional Neural Networks

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Infer the basics and fundamentals of digital image processing

CO2: Apply the various techniques for intensity transformations functions. Implement color image smoothing and sharpening.

CO3: Illustrate Morphological operation and apply Some Basic Morphological Algorithms.

CO4: Apply image segmentation techniques such as Optimum Global Thresholding, Active Contours: Snakes and Level Sets for various real-time applications.

CO5: Analysis various Feature Extraction methods and implement for various real-time applications.

CO6: Apply and Analysis various Image Pattern Classification methods such as Minimum-Distance Classification, Optimum (Bayes) Statistical Classification, and Neural Network

TEXT AND REFERENCE BOOKS:

1. Rafael C Gonzalez, Richard E Woods, “Digital Image Processing”, 4th Edition, Pearson, 2018.
2. Kenneth R. Castleman, Digital Image Processing Pearson, 2006.
3. Anil K.Jain, “Fundamentals of Digital Image Processing”, Person Education, 2003.
4. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Digital Image Processing using MATLAB Pearson Education, Inc., 2011.
5. D,E. Dudgeon and RM. Mersereau, Multidimensional Digital Signal Processing Prentice Hall Professional Technical Reference, 1990.
6. William K. Pratt, Digital Image Processing John Wiley, New York, 2002
7. Milan Sonka et al Image processing, analysis and machine vision Brookes/Cole, Vikas Publishing House, 2nd edition, 1999

INFORMATION HIDING TECHNIQUES

Semester	VII				
Course code					
Category	Professional Elective Courses				
Course title	Information Hiding Techniques				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. To learn about data hiding applications and their techniques.
2. To learn about hacking.
3. To learn security-based protocols, attacks and intrusions.
4. To work with advance data hiding techniques.

UNIT - II

Introduction to Information Hiding: Types of Information Hiding, Applications, Importance & Significances. Differences between cryptography and steganography, Wisdom from Cryptography, types of steganography their application and significances. Past present and future of steganography

UNIT - II

Framework for Secret Communication, Security of Steganography System, Information Hiding in Noisy Data, Adaptive versus non-Adaptive Algorithms, Active and Malicious Attackers, Information hiding in Written Text, Steganographic system, Study of Different methods of insertion and retrieval of message using image steganography, Study of histrogram analysis using MATLAB of original image and stegno image

UNIT - III

Basics of watermarking, Watermarking process, Watermarking applications, Requirements and Algorithmic Design Issues, Evaluation and Benchmarking of Watermarking, Bit plane of an Image, study of noises in stego images and their comparisons, Robustness of watermarking schemes on different attacks like blurring, cropping , compression of theimage. PSNR calculation of the images.

UNIT - IV

Use of image steganography in biometric sciences, Study of security enhancement of biometric template using steganographic Frame proof codes:-Definition, Introduction of frame proof codes, Methods to obtain 2- frame proof codes using mutually orthogonal latin squares. Use of frame proof codes in ownership and software piracy.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Explain information security.

CO2: Give an overview of access control of relational databases.

CO3: State the basic concept in information systems security, including security technology and principles, software security and trusted systems and IT security management.

CO4: Learn advance data hiding techniques.

CO5: Understand how to apply these data hiding techniques in real-life projects.

TEXT AND REFERENCE BOOKS:

1. Recent Advancesin Information Hiding and Applications, Pan, J.-S., Huang, H.-C., Jain, L.C., Zhao, Y., Springer (2013).
2. Information Hiding Techniques for Steganography and Digital Watermarking, Stefan Katzenbeisser, Fabien A. P. Petitcolas, Artech House, 2000.

8TH SEMESTER

B.Tech. (Computer Science and Engineering- Artificial Intelligence & Machine Learning)
Scheme of Studies/Examination w.e.f. 2023-24

Semester - VIII

S. No.	Category	Course Code	Course Title	Hours Per week			Total Contact Hrs. per week	Credits	Examination Schedule (Marks)				Duration of Exam (Hours)
				L	T	P			Marks of classwork	Theory	Practical	Total	
1.	**ESC**		MOOC – 1 (Essential)	3	-	-	-	3	-	-	-	100	-
2.	**ESC**		MOOC – 2 (Essential)	3	-	-	-	3	-	-	-	100	-
3.	**PROJECT**		Project – III/Industrial Training	0	0	16	16	8	150		150	300	3
			Total	**6**	**0**	**16**	**22**	**14**	**150**	**-**	**150**	**500**	

NOTE: At the end of the 8th semester, each student has to submit the certificate of MOOCs (Essential).

PROJECT – III

Semester	VIII				
Course code					
Category	Project				
Course title	Project - III				
Scheme and Credits	L	T	P	Credits	
	0	0	16	8	
Classwork	150 Marks				
Practical	150 Marks				
Total	300 Marks				
Duration of Exam	03 Hours				

COURSE OBJECTIVE

1. To allow students to demonstrate a wide range of the skills learned during their course of study by asking them to deliver a product that has passed through the design, analysis, testing and evaluation
   To encourage multidisciplinary research through the integration learned in a number of courses.
2. To allow students to develop problem solving, analysis, synthesis and evaluation skills.
3. To encourage teamwork.
4. To improve students' communication skills by asking them to produce both a professional report and a professional poster and to give an oral presentation

Students will be assigned projects individually or in a group of not more than 3 students depending on the efforts required for completion of project.

The project will have 4 stages:

(*Marks for internal evaluation are given in brackets)

5. Synopsis submission (10 marks)
6. 1st mid-term progress evaluation (10 marks)
7. 2nd mid-term progress evaluation (10 marks)
8. Final submission evaluation (20 marks)

The external examiner will evaluate the project on the basis of idea/quality of project, implementation of the project, project report and/or publication and viva.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Demonstrate a sound technical knowledge of their selected project topic.
CO2: Undertake problem identification, formulation and solution.
CO3: Design engineering solutions to complex problems utilising a systems approach.
CO4: Conduct an engineering project.
CO5: Communicate with engineers and the community at large in written an oral form.
CO6: Demonstrate the knowledge, skills and attitudes of a professional engineer.

MOOC - I

Semester	VIII				
Course code					
Category	Engineering Science Course				
Course title	MOOC - I				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	-				
Practical	-				
Total	100 Marks				
Duration of Exam	-				

A student has to complete NPTEL Courses of 12 Weeks respectively through MOOCs. For registration to MOOCs Courses, the students shall follow NPTEL Site http://nptel.ac.in/ as per the NPTEL policy and norms. The students can register for these courses through NPTEL directly as per the course offering in Odd/Even Semesters at NPTEL. These NPTEL courses (recommended by the University) may be cleared during the B. Tech degree program (not necessary one course in each semester). After successful completion of these MOOCS courses the students, shall, provide their successful completion NPTEL status/certificates to the University (COE) through their college of study only.

MOOC - II

Semester	VIII				
Course code					
Category	Engineering Science Course				
Course title	MOOC - II				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Classwork	-				
Practical	-				
Total	100 Marks				
Duration of Exam	-				

A student has to complete NPTEL Courses of 12 Weeks respectively through MOOCs. For registration to MOOCs Courses, the students shall follow NPTEL Site http://nptel.ac.in/ as per the NPTEL policy and norms. The students can register for these courses through NPTEL directly as per the course offering in Odd/Even Semesters at NPTEL. These NPTEL courses (recommended by the University) may be cleared during the B. Tech degree program (not necessary one course in each semester). After successful completion of these MOOCS courses the students, shall, provide their successful completion NPTEL status/certificates to the University (COE) through their college of study only.